

OCTOBER 8, 2007

C&EN

CHEMICAL & ENGINEERING NEWS

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of applications. **PAGE 13**



QUOTE OF THE WEEK

"If you want
renewable fuels,
there are going
to be a lot of
unintended
consequences.
It is a feedstock-
limited world."

LOUIS BURKE,
MANAGER, ALTERNATIVE
ENERGY PROGRAMS,
CONOCOPHILLIPS
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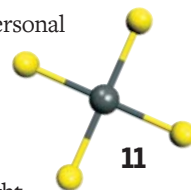
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COVER: Solvent shoots from an electrospray ionization source (right) at liquid samples spotted on the white hydrophobic, disk-shaped substrates. A probe (left) then suctions desorbed analyte into a mass spectrometer. Courtesy of Prosolia/photo by Chris Bucher

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bioprospectors
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CHINA'S RETURNEES AND RETAINEES

IN HIS EDITORIAL "China's Returnees," Rudy Baum observes that those young people who came from China as students, completed their degrees, and gained industrial experience in the U.S. are now returning to China, "helping advance drug discovery to world-class status and making their fortunes in the bargain (C&EN, May 28, page 5)." Concerned about the trend of losing talent, he contends: "The U.S. can no longer take for granted that it can attract and retain scientific talent, even if we do relax ill-conceived barriers to immigration."

The policy change from the debate is yet to be felt, while "the leveling effect" described by writer Thomas L. Friedman continues to ripple through the chemical sector.

Paradoxically, as the "returnees" trend appears to gain momentum, I see more "retainees" as well. I have observed that many chemists-turned-businessmen of Chinese origin decide to continue thriving in the U.S. These are usually midcareer folks with families residing in the U.S. They are more tempted by the business environment and the rules of commerce. Although many do not receive venture-capital funding, hard work and technical competence in a relatively low-risk industry seem to spell success.

The businesses are normally focused on providing technological services such as custom synthesis, intermediates supply, and pharmaceuticals analysis. Many businesses are about 10 years old and now enjoy organic growth that contributes to the overall well-being of the economy. I've also observed a gradual increase of such companies, as evident at recent ACS and other trade shows. As more chemists become professionally mature, this trend may continue.

Admittedly, the definition of returnees and retainees has been blurred. The returnees representing U.S.-based companies operate overseas and provide a bridge to support the global operations of the parent companies. In the end, it is the parent businesses and local communities (presumably) that benefit from having retained their services in different geographic sites. On the other hand, the retainees, under pressure to stay competitive, have "returned" to their home country, often intermittently, to search for more affordable materials and other opportunities.

The significance of returnees and retain-

ees should not be overlooked. Being technically, socially, and culturally experienced, they play critical roles in interfacing the engagement of the two nations to much deeper levels that will be beneficial to us all.

Warren Wang
Silver Spring, Md.

PENTAZOLE ANION

I ENJOYED reading "Molecules That Could Be" (C&EN, Aug. 13, page 17). I wanted to add that the organic materials research group at Vanderbilt University was also involved in the chemistry of the pentazole anion N_5^- . Comparing our gas-phase computational results with experimental data obtained in methanol, we estimated the stability of the anion and conjugate acid (N_5H) in methanol solutions at 0 °C. The estimated half-lives were 2.2 days and 10 minutes, respectively (*J. Org. Chem.* **2002**, *67*, 1354). Such estimates in condensed phase provide much more tangible information about the compound's stability and are a better guide for experimental chemists rather than calculations of isolated molecules in the gas phase.

I thought that this information would provide a more complete picture in your article and be helpful to your readers.

Piotr Kaszynski
Nashville

YOU BE THE CHEMIST CHALLENGE

I ENJOYED reading about the success of the 2007 U.S. National Chemistry Olympiad Study Camp, and I congratulate all participants, mentors, organizers, and supporters (C&EN, June 25, page 3). It is obviously an event that takes a huge amount of effort from all involved. I would like to inform your readers of another academic competition geared toward a younger group. Called the "You Be the Chemist" (YBTC) Challenge, it is designed to promote the study of chemistry and the benefits of chemicals.

The competition is organized by the Chemical Educational Foundation, a non-profit organization based in Arlington, Va. CEF's academic competition brings together the chemical industry, students, educators, and community members in an effort to gain a stronger appreciation of the sciences.

To develop this appreciation CEF be-

believes it is important to start young, and so YBTC is aimed at students in grades 5–8. Nationwide, individual companies sponsor local and state competitions. Participants are quizzed on chemistry concepts, important historical discoveries, and safety tips.

Winners are selected from each state, and in June, CEF brings the competitors together, with a parent or guardian, for the final competition in Philadelphia. There, they compete for the title of National YBTC Challenge Champion, receive prizes, and participate in group activities and outings around the city. For the 2008 Challenge, CEF expects 20 states and as many as 10,000 students to participate, with more than 30 companies sponsoring various portions of the competition.

I invite and encourage your readership to get involved in this and other CEF activities. It is through such collaborations of industry, the communities in which they do business, and national organizations such as CEF that we can improve standards in science education—a clear benefit to all in the chemical industry and the nation as a whole.

For more information, visit our website at www.chemed.org.

John Michael Rice
Managing director, CEF
Arlington, Va.

MARTINI CHEMISTRY

EBEN KLEMM'S REMARKS in Newscripsts on the release of more antioxidants in a shaken martini compared with a stirred one (C&EN, Aug. 6, page 48) reminded me of previous links between the martini and chemistry periodically mentioned in Ken Reese's Newscripsts in the years 1971–97.

I wrote a short note with an accompanying table using the martini as a means of enlivening solution concentration problems that are part and parcel of any introductory chemistry course (*J. Chem. Educ.* **1967**, *44*, 199). I asked my class how many times stronger in alcoholic content a “super-strong” martini (100:1) is than the standard 3:1 variety.

When students make the actual calculations, they receive a real surprise. The alcoholic content rises from 37.0% for the 3:1 drink to only 42.8% for the 100:1 drink. In fact, the alcoholic content is 43.0% for pure gin. The increase between the two extremes is only 6.0%—a classic example of cognitive dissonance. The calculations impress on students the fact that the intuitive, “obvious,” *prima facie* answer is not always the correct one and that in many cases detailed quantitative calculations may yield results that at first may seem contrary to “common sense.”

In a later article (*Chem. Ind.* **2001**, *24*, 795), I pointed out that although shaking produces a colder cocktail more quickly than stirring, a substantial part of

the martini's charm is its “eye appeal”—its clear, almost scintillating translucence. A stirred cocktail will remain clear, while a shaken one will be cloudy or muddy because of dissolved air, especially if vermouth or other wine is present.

Readers interested in the detailed chemistry, history, and assorted lore of the martini and its ingredients may wish to consult my illustrated article (*Chem. Educator* **2001**, *6*, 295).

George B. Kauffman
Fresno, Calif.

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news of the week

OCTOBER 8, 2007 EDITED BY WILLIAM G. SCHULZ & KIMBERLY R. DUNHAM

FINE CHEMICALS UPSWING

PHARMACEUTICAL INGREDIENTS:

At CPhI, suppliers say they are spending again

THE 20,000-PLUS ATTENDEES at CPhI—the conference on pharmaceutical ingredients—climbed stairs, rode escalators, and planned for lengthy walks between appointments at the sprawling Milano Fiera Rho exposition center in Milan last week, where the fine chemicals industry showcased new technologies and investments. By most accounts, the industry's comeback from a years-long slump is still in full swing.

For many chemical companies in attendance, the investments are aimed at attracting business from start-up pharmaceutical firms. These small companies typically require highly specialized chemistry, manufacturing starting at preclinical stages, and a range of other services that big pharma customers don't need.

Isochem CEO Thierry Malfroot told C&EN that “2004 was the black year for Isochem. But each year, we have done a little bit better than the previous year.” Isochem, the fine chemicals unit of the state-owned French company SNPE, expects to finish 2007 with revenues 3% higher than earlier estimates.

Xavier Jeanjean, Isochem's sales director, attributes the comeback to a broadening of analytical and regulatory services and a reorganization of R&D. Together, the changes have boosted business with emerging drug companies, which now account for 40% of Isochem's revenue.

This year, the firm invested \$4 million in improving pilot-manufacturing capabilities. Meanwhile, Malfroot disclosed that SNPE is “very, very close to a sale” of its peptides business, NeoMPS, which has facilities in Strasbourg, France, and San Diego. SNPE has said it will sell all of Isochem in the next two years.

Also investing in facilities is Carbogen Amcis, which has spent nearly \$8.5 million on its three Swiss operations during the past year, adding microreactors in Neuland, crystallography capacity in Aarau, and a large-scale liquid chromatography unit in Bubendorf, according to CEO Mark Griffiths.

Griffiths said Carbogen's acquisition by India's Dishman Pharmaceuticals & Chemicals last year has allowed the Swiss firm to pursue a “different business model.” He said it can take on larger projects with support from India and a Dishman-owned nonpharma-

ceutical synthesis plant in Manchester, England. Its Swiss facilities can concentrate on their specialty: manufacturing high-potency drugs.

With this package, Griffiths said, Carbogen is well-positioned to pursue synthesis of cancer therapies on behalf of start-up drug companies that, if successful, are likely to be purchased by major drugmakers. “If you are in there at the early stage,” he said, “you generally move forward with the project” following any acquisition.

Fine chemicals companies continue to shy away from the massive expansions and acquisitions of the late 1990s. But a spate of smaller investments in niche technologies was announced at CPhI.

SAFC is building a new plant in St. Louis devoted to the conjugation of highly potent pharmaceutical chemicals to deliver molecules such as monoclonal antibodies. Expected to open by the end of the year, the production suite will produce early-stage clinical supplies of conjugates and have room for expansion.

Ash Stevens said it has invested about \$2.5 million during the past eight months to add high-containment capacity at its Riverview, Mich., site. The expansion includes a 100-L pilot plant with cryogenic capabilities. The pilot plant allows Ash Stevens to model a process in the lab and seamlessly bring it to full-scale production, said CEO Stephen Munk.

Meanwhile, Ampac Fine Chemicals plans to invest \$3.3 million at its Rancho Cordova, Calif., facility. The expansion will support customers' compounds in Phase I or II clinical trials while further extending its continuous-processing capabilities.

Flamma, the Italian contract manufacturer, is lowering costs with a new R&D facility in Shanghai and a manufacturing joint venture in Gonggan, China. The company, which specializes in amino acid chemistry, has also spent some \$11 million to increase capacity at its Bergamo, Italy, plant by 40%, according to Beppe Gornati, commercial director.

The Italian investment is almost half of the firm's annual sales of about \$25 million. “It is a very big investment for us,” Gornati acknowledged, “but we need to make it, and we can afford it at this time.”—RICK MULLIN



RICK MULLIN/C&EN

CPhI attracted thousands of pharmaceutical and fine chemicals executives to Milan.

TEACHING SCIENCE

EDUCATION: National Science Board makes bold proposals for bolstering science education system

Beering and fellow NSB members Jo Anne Vasquez (center) and Elizabeth Hoffman roll out the new STEM education action plan.



SUSAN MORRISSEY/C&EN

THE NATIONAL SCIENCE BOARD has recommended that Congress establish a national council for science, technology, engineering, and mathematics (STEM) education. The recommendation is part of an ambitious action plan that NSB proposed last week to shore up the faltering system of STEM education in the U.S.

The plan emphasizes actions that can be taken at the federal level, and several members of Congress said they support its recommendations.

“Addressing the shortcomings of the nation’s science, technology, engineering, and mathematics education system is absolutely essential to the continued economic

success of the nation and to its national security,” said NSB Chairman Steven C. Beering at the plan’s release on Oct. 3 at the U.S. Capitol. NSB is the governing body of NSF. “Unless there is a broad pool of K–12 students with a solid foundation in STEM disciplines, it will be very difficult for the U.S. to develop the mathematicians, scientists, and engineers the nation needs.”

The board has identified as the major challenges facing the education establishment a lack of coherence in STEM education programs across individual school systems and a need for more well-trained STEM teachers. The board recommends establishing a national council that would coordinate local, state, federal, and nonfederal efforts to solve these problems.

Other recommendations include the creation of a committee on STEM education in the White House National Science & Technology Council to coordinate federal efforts, the appointment of a STEM expert as an assistant secretary of education in the Department of Education to coordinate that agency’s efforts, and the creation of a national road map by NSF to improve STEM education.

House Science & Technology Committee Subcommittee on Research & Science Education Chairman Brian Baird (D-Wash.), who attended the plan rollout, pointed out that his subcommittee will hold a hearing on the report on Oct. 10, and Rep. Michael M. Honda (D-Calif.) noted that he is already working on legislation to improve STEM education.—SUSAN MORRISSEY

PAIN RELIEF MINUS SIDE EFFECTS

ANESTHESIA: Compound combo selectively mutes pain-sensing nerves

CAPSAICIN—the ingredient that gives chili peppers their heat—turns the lidocaine derivative QX-314 into an injectable local anesthetic that blocks pain without causing the paralysis or numbness associated with most local anesthetics. This activity profile could be useful in childbirth, treatment of some

forms of chronic pain, and other circumstances in which a patient wants to maintain motor capabilities as well as awareness of nonpainful sensations.

The compound blend works by blocking sodium ion channels in nerves that sense pain, thereby preventing the nerves from transmitting pain signals to the brain, according to neurobiologist Bruce P. Bean of Harvard Medical School, anesthesia re-

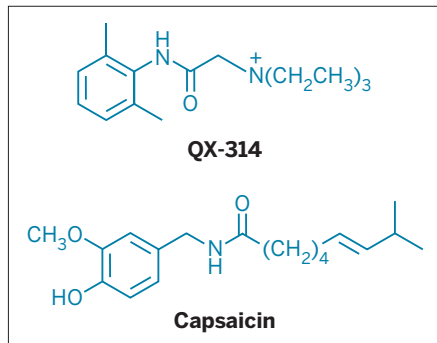
search chair Clifford J. Woolf of Massachusetts General Hospital, and Woolf’s postdoc Alexander M. Binshtok (*Nature* 2007, 449, 607).

As a result of the findings, QX-314, “which was until now just an exotic reagent used by ion-channel biologists, will be the focus of a new effort in the search for better analgesics,” says neuroscientist Edwin W. McCleskey, scientific officer at Howard Hughes Medical Institute, in Bethesda, Md. (*Nature* 2007, 449, 545).

Most local anesthetics move into nerve cells by taking on an uncharged form that can readily pass through the cells’ oily lipid membrane. The anesthetics then plug the cells’ sodium channels from the inside. This entry method is nonselective, however, so these anesthetics can enter nerve cells that control functions unrelated to pain, such as movement.

By itself, QX-314 is unable to get through the lipid membrane of nerve cells because it is positively charged. But tests in rats show that capsaicin provides QX-314 an entrée to the cells by opening their so-called TRPV1 ion channels. QX-314 passes through these channels into the cells and then plugs the sodium channels. Because the TRPV1 ion channels are found only on pain-sensing nerve cells, QX-314 activity is limited to these cells alone.

“Now we can block the activity of pain-sensing neurons without disrupting other kinds of neurons that control movements or nonpainful sensations,” Bean says.—SOPHIE ROVNER



TURNING WATER INTO FUEL

SOLAR ENERGY: Silicide compound and sunlight convert water to H_2 and O_2

IN A TWO-FOR-ONE DEAL that may give the solar energy field a shot in the arm, researchers have discovered a semiconducting silicide that functions effectively as a water-splitting photocatalyst and doubles as a gas separator (*Angew. Chem. Int. Ed.*, DOI: 10.1002/anie.200701626).

Using sunlight to liberate hydrogen from water is an appealing way to generate a clean-burning fuel from a renewable energy source. As a result, scientists have examined a variety of materials over the years in search of a suitable catalyst to accelerate the water-splitting reaction. Several candidates show some level of promise, yet each material suffers from shortcomings that would limit its applications. For example, some catalysts absorb solar radiation inefficiently, exhibit low activity, or are unstable or costly.

Now, a team of researchers at the Max Planck Institutes for Bioinorganic Chemistry and for Coal Research, in Germany, reports that titanium disilicide ($TiSi_2$)—an abundant and inexpensive semiconductor not known previously to be a water-splitting catalyst—separates water into hydrogen and oxygen when reactors containing the powdered catalyst are illuminated with simulated sunlight.

“Titanium disilicide has very unusual optoelectronic properties that are ideal for use in solar technology,” says research group leader and bioinorganic chemist Martin Demuth. Specifically, the material absorbs light over a wide range of the solar spectrum and exhibits a bandgap—an important determinant of semiconductor properties—that varies by nearly

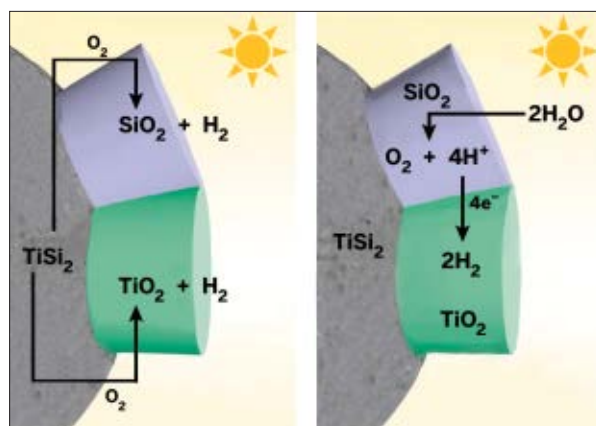
2 eV across that range. Semiconductors typically exhibit a much narrower variation in bandgap.

Another key observation reported by the team is that hydrogen evolves readily during experiments, but oxygen adsorbs reversibly on the catalyst surface. Raising the temperature above 100 °C rapidly releases the stored oxygen, they say, which provides a convenient way to separate the gases.

On the basis of control experiments, isotope-labeling tests, and other measurements, the researchers propose that exposing commercial $TiSi_2$ to light in the presence of a small amount of oxygen (as found in water that has not been degassed) leads to formation of catalytically active sites. These nanometer-sized domains of oxidized species catalyze the water-splitting and gas-forming reactions, they say.

As news of the findings begins to spread, some scientists are puzzling over the unusual properties reported for $TiSi_2$. At the National Renewable Energy Laboratory, for example, senior research fellow Arthur J. Nozik notes that the “curiously” varying bandgap implies that the material is neither pure nor homogeneous. It is unclear, he says, whether this range represents individual particles with distinct chemical composition or a graded composition for individual particles, which suggests that the mechanism is not well-understood.

Demuth agrees that the behavior is “atypical” but adds that he has founded a start-up company to further study, develop, and possibly commercialize the technology.—MITCH JACOBY



Sunlight and residual oxygen form active domains of oxide species (purple and green regions) on the surface of $TiSi_2$ particles. These species catalyze formation of H_2 and O_2 from water.

COURTESY OF MARTIN DEMUTH

ENVIRONMENT Dow Corning undertakes waste-to-energy project

Silicones maker Dow Corning has started a \$50 million project to outfit its Midland, Mich., plant with equipment intended to reduce carbon dioxide emissions by 20%, cut other emissions by 75%, recycle hydrochloric acid, and lower annual natural gas consumption by 400 billion Btu—enough to heat more than 3,500 homes during the winter.

The project, set for completion in mid-2008, will depend on a plasma-based waste-processing system, the first of its kind to be installed in the U.S. Integrated Environmental Technologies (IET) will

own the system, which will handle more than 6,600 tons of waste per year.

Dow Corning begins the silicone-manufacturing process with chlorosilanes. It will feed chlorinated organic waste generated during chlorosilane production to IET's plasma-enhanced melter. The plasma system will separate the wastes into organic and chlorine streams. Dow Corning will pay IET to manage the waste streams.

The system will then convert the organic stream into a synthetic gas, which will be burned to generate steam. It will

also convert the chlorine stream into hydrochloric acid, which Dow Corning will recycle back into its chlorosilane process. A small amount of remaining waste material will be converted into an inert obsidian-like glass that, according to Dow Corning and IET officials, will initially be sent to a landfill but may eventually be recycled for uses such as sand blasting.

IET will spend \$18 million to install the plasma equipment. Dow Corning will put up the remaining \$32 million, which covers infrastructure improvements and other equipment costs.—MARC REISCH

DOE WEAPONS PLAN NEEDS IMPROVEMENT

NEW WARHEAD: Science panel challenges nuclear weapons development process

Lawrence Livermore National Laboratory in California was selected to engineer a new generation of nuclear warheads.



THE DEPARTMENT of Energy should overhaul its process to design and produce a new family of nuclear weapons, says a recent report by JASON, an influential government advisory panel of academic scientists.

For several years, DOE's National Nuclear Security Administration has been designing a "reliable replacement warhead" to replace its current stockpile of some 10,000 nuclear weapons. The RRW will be safer and

more secure, easier to manufacture, and more difficult to detonate if captured, NNSA says. It wants the weapon in production by 2012 and has selected Lawrence Livermore National Laboratory to engineer the RRW with support from Sandia National Laboratories.

However, NNSA's plan has run into opposition due to nuclear weapon proliferation concerns, costs, and the fear that it will lead to a return to underground testing (C&EN, March 19, page 34).

"The [JASON] report's take-home message is that NNSA is following good scientific procedures, but there are some areas where more work is going to be needed," says Roy F. Schwitters, chairman of the JASON steering committee and a physicist at the Uni-

versity of Texas, Austin. "In this new world of developing new nuclear weapons without underground testing, the question is, 'What can replace the confidence-building role of an underground nuclear test?'"

While NNSA has stressed the view that the new weapon can be designed on the basis of past nuclear test data, the report finds that the current NNSA experiments and analyses using that data are inadequate.

Schwitters also underscores the importance of peer review and the need to create a new, highly visible, and broadly constituted peer review system led by the weapons lab not involved with the RRW, Los Alamos National Laboratory. Overseeing a nuclear weapons project requires oversight by weapons experts, Schwitters says, but LANL should draw reviewers from as broad a range as possible.

Schwitters recommends appointment of a "top-level monitor" to ensure the overall review is really independent. The monitor should be a widely recognized person or blue-ribbon panel, reporting to Congress, the public, and the President, he says.

JASON's criticisms in part mirror those of the chairman and the ranking member of the House Appropriations Committee with DOE oversight, respectively, Reps. Peter J. Visclosky (D-Ind.) and David L. Hobson (R-Ohio), who called for the JASON study.

In a joint statement, Visclosky and Hobson say, "Once again, independent sources have raised serious questions that must be addressed before proceeding with the RRW." They also urged the President to develop a "substantive nuclear weapons strategy" before investing "billions of dollars to transform the nuclear weapons arsenal and manufacturing complex."

NNSA Administrator Thomas P. D'Agostino responded positively to the report, saying it shows "we are on the right track" and that with enhancements NNSA can certify the RRW for addition to the U.S. nuclear weapons stockpile without underground testing.—JEFF JOHNSON

PHARMACEUTICALS Novartis and MIT to research continuous manufacturing

Novartis and MIT have launched a partnership aimed at transforming pharmaceutical manufacturing. Novartis hopes the pact will allow it to convert its drug production infrastructure from multisite batch operations to continuous ones that consolidate chemical synthesis, formulation, and packaging in one location.

The drug company is investing \$65 million in research at MIT over the 10-year period of the partnership. The project will involve seven to 10 MIT faculty members, as well as students, postdoctoral fellows, MIT staff scientists, and Novartis engineers and scientists. Research will be conducted

primarily through MIT Ph.D. programs and then transferred to Novartis for further development to industrial-scale projects.

Thomas Van Larr, head of global technology operations for Novartis, says the drug industry's heritage in batch manufacturing stems in part from the relatively small volumes of high-value active ingredients needed to make drugs. However, many products, such as Novartis' blood pressure medication Diovan, are produced at a volume that could support continuous chemical production, according to Van Larr.

Most major drug companies are ex-

ploring options for continuous processing, and some are working together. Pfizer, GlaxoSmithKline, and AstraZeneca, for example, are members of a U.K.-based manufacturing innovation consortium called Britest (C&EN, Jan. 22, page 11).

But Bernhardt L. Trout, associate professor of chemical engineering at MIT and director of the Novartis MIT Center for Continuous Manufacturing, says the exclusive partnership means researchers can focus more directly on intense process development. "This project is going to drive the industry," Trout says. "Other companies will follow suit."—RICK MULLIN

SHRINKING THE DEAD ZONE

GULF OF MEXICO: Draft report faults corn-based ethanol

TO SHRINK THE dead zone in the northern Gulf of Mexico, the U.S. may need to reform agricultural subsidies and financial incentives for corn-based ethanol, according to a draft report from EPA science advisers.

The gulf's dead zone, characterized by extremely low levels of oxygen, or hypoxia, grew to a near-record 20,500 km² this summer. When final, the report is expected to influence a federal-state task force that is updating an action plan to minimize the dead zone.

To shrink the dead zone to its historic size of 5,000 km², the draft report recommends cutting the amounts of nitrogen and phosphorus carried by the Mississippi River into the gulf by at least 45%. These plant nutrients encourage excessive growth of phytoplankton, which eventually die and are eaten by bacteria that consume much of the oxygen in the water, leading to hypoxia.

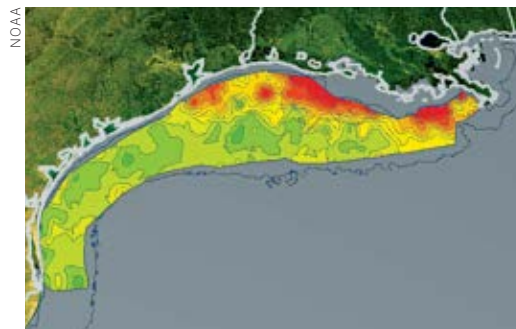
The draft report warns that U.S. agricultural subsidies and the economic incentives favoring corn-based

ethanol "are at odds with the goals of hypoxia reduction." It identifies five "significant opportunities" for reducing the amount of nitrogen and phosphorus entering the Mississippi. One is for farmers in the Midwest to convert to crops for producing cellulosic ethanol, which require less fertilizer than corn, or rotate corn with other crops. Another is helping farmers better manage fertilizer use to curb runoff. A third involves use of conservation buffers to capture nutrient-laden runoff before it enters surface water.

In addition, wastewater treatment plants need to lower the amount of nitrogen and phosphorus they discharge, the draft report says. A fifth recommendation is to construct or restore wetlands, which can absorb nitrogen and phosphorus before they get to the river.

EPA's Science Advisory Board was scheduled to vote on approval of the draft report last week. But the advisers delayed their decision until December to allow for technical revisions to the draft.

Virginia H. Dale, corporate fellow at Oak Ridge National Laboratory and chair of the board's Hypoxia Advisory Panel, tells C&EN she expects no substantive changes to the draft report's recommendations before it is finalized.—CHERYL HOQUE



Areas of low oxygen concentration, shown in red and orange, form the dead zone off the coast of Louisiana and Texas.

MERCURY TETRAFLUORIDE SYNTHESIZED

INORGANIC CHEMISTRY: Elusive Hg(IV) species prepared in solid argon, neon

MERCURY, a group 12 element with a valence electron configuration of s^2d^{10} , is generally considered to be limited to the +1 and +2 oxidation states. Theoretical work, however, has long predicted that mercury could be stable in the +4 oxidation state. In a fundamental advance that opens new possibilities for mercury compounds, that prediction has now been confirmed with the successful synthesis of HgF₄ using matrix isolation techniques (*Angew. Chem.*, DOI: 10.1002/anie.200703710).

HgF₄ was prepared in cryogenic conditions by reacting mercury with excess fluorine in either an argon or a neon matrix, with ultraviolet irradiation from a mercury arc lamp. According to chemistry professor W. Lester S. Andrews at the University of Virginia, who did the experimental work with senior research scientist Xuefeng Wang, two factors were critical to the success of the experiments. These were controlling the light intensity,

since HgF₄ is photosensitive, and using neon to improve the yield. Neon has a lower melting point than argon and thus is more permeable to fluorine at 4 K and gives higher yields of HgF₄.

Andrews and Wang confirmed the identity of the species by comparing experimental infrared spectra with vibrational frequencies from coupled-cluster and density functional calculations. The theoretical analysis was done by Sebastian Riedel, now a postdoc at the University of Helsinki, in Finland, and chemistry professor Martin Kaupp at the University of Würzburg, in Germany.

Although the researchers have not yet obtained structural data on HgF₄, prior computations by Kaupp predicted that it would be a low-spin d^8 species with square-planar geometry and that the mercury d -orbitals would be strongly involved in bonding, just as in other transition metals.

The work is likely to stimulate renewed efforts to synthesize other Hg(IV) species, says Gary J. Schrobilgen, a chemistry professor at McMaster University, in Canada, who has attempted to synthesize high-valent mercury fluorides. One likely target is HgF₆²⁻, since an anion would likely help to stabilize the metal's high oxidation state.—JYLLIAN KEMSLEY



TETRAVALENT MERCURY

The matrix isolation apparatus shown above was used to produce HgF₄ (shown with mercury in gray and fluorine in yellow).

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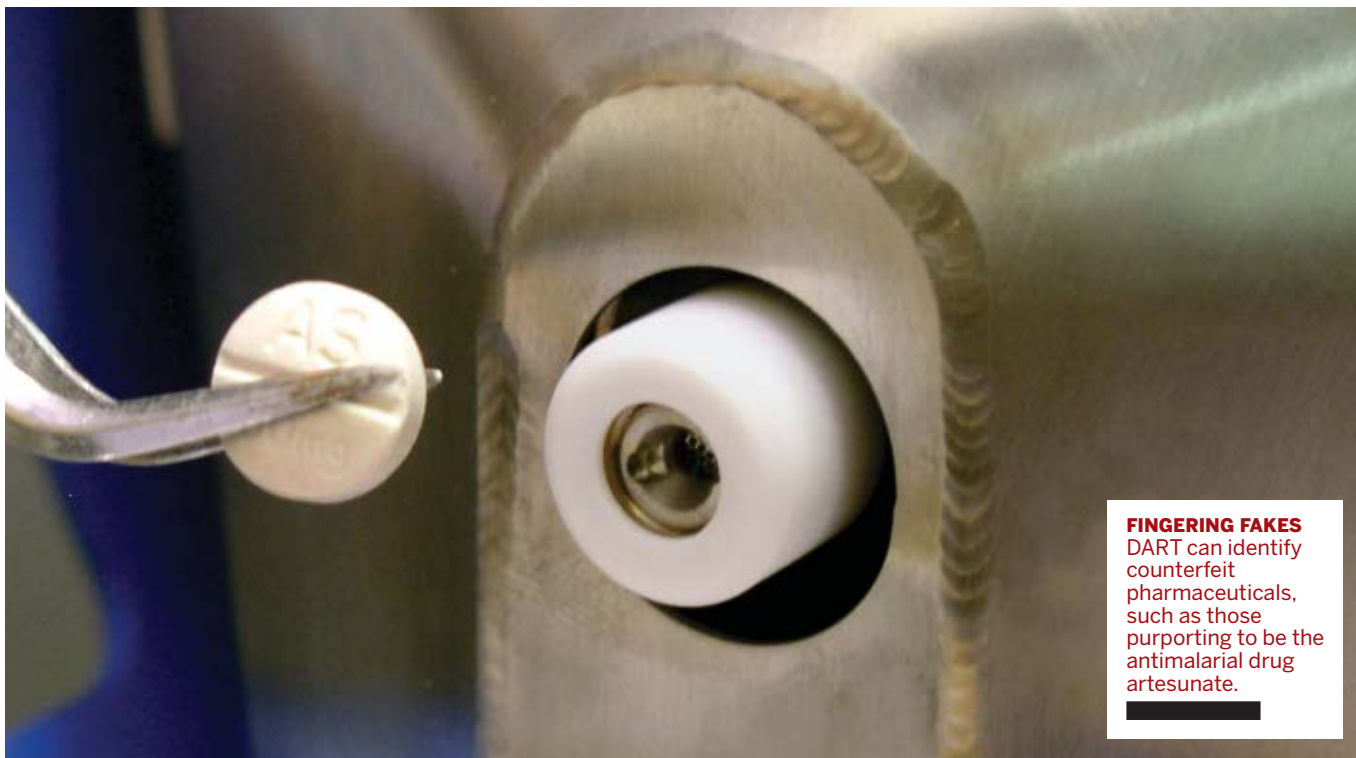
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DART can identify counterfeit pharmaceuticals, such as those purporting to be the antimalarial drug artesunate.

TAKING MASS SPEC INTO THE OPEN

Open-air ionization methods **MINIMIZE SAMPLE PREP** and widen range of mass spectrometry applications

CELIA HENRY ARNAUD, C&EN WASHINGTON

JEANETTE ADAMS gets excited talking about all the things she can do with mass spectrometry at the Library of Congress. A scientist in its Preservation Research & Testing Division, Adams uses mass spectrometry to look for early signs of degradation in documents, photographs, and microfilm from the library's collections. In most cases she does so without even taking a sample, thanks to an ionization method called DART (direct analysis in real time).

DART is just one of a new generation of ambient ionization methods. Others include DESI (desorption electrospray ionization) and ASAP (atmospheric solids analysis probe). These new methods are expanding the already vast array of mass spectrometry applications.

"We have to think more broadly because now we're able to analyze the real world,"

says Gary J. Van Berkel, mass spectrometry group leader at Oak Ridge National Laboratory. "What are we going to look at?"

Mass spectrometrists are taking that question seriously and using these and related ionization techniques for a variety of applications, ranging from pharmaceutical quality assessment to forensic analysis to cultural heritage conservation.

Ionization is a necessary first step for any mass spectrometric analysis because the mass analyzer separates charged particles on the basis of their mass-to-charge ratio. Ionization has traditionally been done within the spectrometer's vacuum system. This newest crop of methods moves ionization into the open.

In DESI (invented by R. Graham Cooks and coworkers at Purdue University), a stream of charged solvent droplets bom-

bards the sample surface, desorbing molecules into a stream of small droplets that goes into the mass spectrometer. (*Science* 2004, 306, 471)

DART and related ionization techniques are relatives of atmospheric pressure techniques such as atmospheric pressure chemical ionization (APCI) and atmospheric pressure photoionization (APPI).

In DART (invented by Robert B. Cody at instrument maker JEOL and James A. Laramée at government contractor EAI Corp.), a glow-discharge plasma excites an inert gas that subsequently ionizes sample that's remote from the plasma (*Anal. Chem.* 2005, 77, 2297). In ASAP (invented by Charles N. McEwen and coworkers at DuPont), the sample is inserted directly into an APCI source and exposed to a corona discharge carried out in heated nitrogen.

PADI (plasma-assisted desorption ionization, invented by scientists at the University of Nottingham and Hiden Analytical in England) uses a nonthermal plasma generated by a radio frequency (*Anal. Chem.* 2007, 79, 6094).

In each of these methods a plasma ionizes sample molecules (or molecules in the atmosphere that then proceed to ionize the sample). The main differences are in how the plasma is generated and where the sample is introduced.

Small companies are already commercializing DART and DESI. IonSense, located in Saugus, Mass., was founded to develop DART. Indianapolis-based ProSolia is commercializing DESI. For both companies, the challenge has been engineering ionization sources to fit on mass spectrometers from different manufacturers.

These ionization methods—whether commercial or homemade—are finding plenty of applications.

For instance, ambient ionization methods are helping Facundo Fernandez identify counterfeit pharmaceuticals. Fernandez,

an assistant professor of chemistry at Georgia Institute of Technology, collaborates with scientists at the Centers for Disease Control & Prevention and the Wellcome Trust to investigate antimalarial medications collected in Southeast Asia.

Fernandez had already been working on the problem of counterfeit drugs for about two years when he first became aware of DART and DESI. He recognized immediately the potential of these methods to speed up his analyses. Defending against counterfeits requires analyzing many more tablets than does conventional quality control, Fernandez says. “We find a huge variety of counterfeits, even from the same blister pack. You really need to test as many samples as you can,” he says. The minimal sample preparation required for ambient ionization is key to shortening the analysis time.

Now, Fernandez routinely uses both DART and DESI for their different advantages. The DART spectra are usually



COURTESY OF GRAHAM COOKS

simpler than the DESI spectra, he says. But with DESI, by adding reactants to the spray, one can do chemistry to enhance ionization, improve sensitivity, and prevent fragmentation of the antimalarials.

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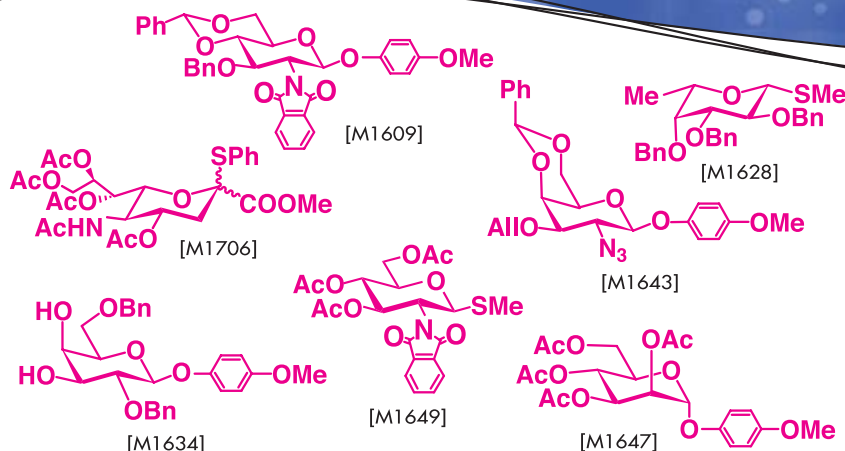
WITH THE AMOUNT of counterfeit drugs in the market, Fernandez would like to see ambient ionization methods move into the field, where they could be used by the people on the ground to monitor the integrity of their drug supplies. Last year, Fernandez analyzed the medications used to treat a patient who died of malaria. The entire supply of antimalarials at the field hospital turned out to be fake.

In addition to quality analysis, ambient ionization methods are also finding use in drug discovery applications. Christopher Petucci, a mass spectrometrist at Wyeth Research in Collegeville, Pa., has used both DART and ASAP. He points out that DART's special ion source increases its cost relative to ASAP, which requires only minor modifications to an existing APCI source.

However, DART and ASAP are “similar in their ability to directly ionize a wide range of small molecules in our lab, from nonpolar compounds like naphthalenes to highly polar compounds such as warfarin,” he says. He has used both techniques to monitor simple organic reactions without chromatographic separation (*Anal. Chem.* 2007, 79, 5064). He currently uses ASAP to quickly ionize nonpolar, high-melting-

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point compounds that do not ionize by electrospray or APCI.

Besides pharmaceutical applications, direct ionization methods can also be used to analyze solid biological samples. Renato Zenobi, a chemistry professor at the Swiss Federal Institute of Technology, Zurich, and coworkers use uncharged streams of nitrogen gas to sample biological surfaces for analysis by a method called extractive electrospray, which is turning out to be closely related to DESI. Zenobi believes, however, that the neutral nitrogen stream is much gentler than the high-voltage electrospray stream used in DESI.

Using neutral desorption, Zenobi and coworkers have analyzed a variety of biological samples (*Angew. Chem. Int. Ed.*, DOI: 10.1002/anie.200702200). For example, they obtained metabolic fingerprints that included nicotine and caffeine from the skin of a male smoker before and after coffee consumption.

FOOD SAFETY ANALYSIS will be a key application, Zenobi believes. Using neutral-desorption sampling, he and his coworkers detected biogenic amines typically associated with meat spoilage, including histamine, putrescine, and cadaverine, in fish exposed to room temperature for one to two days. They also detected *Escherichia coli* bacterial contamination in iceberg lettuce.

DESI is also being developed as a method for mass spectrometric imaging, the use of mass spectral data to visualize a sample.

Such imaging is usually done with matrix-assisted laser desorption/ionization (MALDI) or secondary ion mass spectrometry. Cooks's group, in collaboration with Richard M. Caprioli at Vanderbilt University, has demonstrated DESI images of phospholipid profiles in a variety of tissues (*Angew. Chem. Int. Ed.* 2005, 44, 7094). Prosolia is developing a commercial prototype for DESI imaging.

Van Berkel's group likewise is developing DESI for mass spectrometric imaging, particularly as a replacement for whole-body autoradiography. His team is using DESI to visualize drug distribution in mice that have been dosed with a drug. DESI gives information that is molecularly specific and spatially resolved about both the parent drugs and their metabolites without the need for radioactive tags.

But the sensitivity isn't good enough yet for general tissue-imaging applications, Van Berkel says. "It may be easy to find the drug when administered at a physiological dose, but the metabolites are at lower levels. We find it much more difficult to get good pictures of the metabolites," he says. "Detection levels have to improve by at least a couple of orders of magnitude."

The operating room is where Zoltán Takáts would like to see DESI. Takáts, a mass spectrometrist at Semmelweis University in Budapest, Hungary, is one of the coinventors of DESI. He aims to bring DESI



COURTESY OF RENATO ZENOBI AND ARNO WORTMANN

and a related technique called JeDI (jet desorption ionization) out of the lab and into clinical settings. DESI can be used to analyze tissue surfaces, either on the skin or inside an incision. JeDI, a destructive technique in which a liquid jet erodes the surface, can be used simultaneously to cut tissue and ionize biomolecules.

Both methods can be used to perform real-time histological identification of tissues. "The most important application is the in situ identification of cancerous tissue, which will help surgeons to localize tumors, increase tumor-removal efficiency, and minimize the amount of healthy tissue removed," Takáts says. He and his

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of infiltrating tumors in healthy tissue," he says.

ART CONSERVATION is another area where DART is making a difference. The Library of Congress' Adams is exploring the use of DART to diagnose degradation of materials in its collection.

Many materials could benefit from non-destructive, sensitive detection of marker compounds, such as the acetic acid formed when cellulose acetate films degrade. Called "vinegar syndrome," the reaction is recognizable by the telltale odor. By the time the acetic acid concentration is high enough to smell, further deterioration will occur rapidly. "You want to be able to detect it at lower levels than your nose can," Adams says.

Adams is also using DART to analyze paper. DART is sensitive enough that even when samples must be removed, they can be tiny. "I can tweeze a sample of paper that's the size of the dot on an *i* in a 12-point Times New Roman font," she says. "I can get chemical fingerprints from something that small."

One of the things Adams is doing is revisiting the specifications for materials used to store the Library's collection. "I'm reanalyzing the materials by DART to ensure that we're seeing everything we can see." For example, she analyzed protective sleeves made of Mylar polyester—which usually meet the library's specifications for storing collection items—that were made in DuPont's factory in China. She detected erucamide, a long-chain fatty acid amide used as a slip agent to keep plastic sheets from sticking together. "That's stuff you don't want to have sitting on your collection item," Adams says. "DART picked it up. The same samples looked great" by Fourier transform infrared spectroscopy. It turned out that the erucamide came from materials the Mylar sleeves were shipped in rather than the Mylar itself.

Adams collaborates with conservators such as Adrienne Lundgren, who works with photographs in the library's collection, to help determine how objects should be conserved. They would like to know what materials were used in creating par-

colleagues are currently developing a device for electrosurgery with DESI and JeDI, which has already been tested in mouse and rat models. "It's capable of identifying even traces

ticular photographs, both to understand the artists' methods and to make informed treatment decisions.

For example, platinum prints were coated with a variety of organic substances, Lundgren says. The type of coating dictates the proper treatment. "You don't want to introduce any sort of treatment that will in some way change the artistic integrity of the item," she says. "DART will be helpful because we could determine the coating on each of these prints."

Using DART, they also hope to learn more about the characteristics of photographic papers and dyes from different periods. Such information could help with dating photographs. For example, the use of optical brightening agents is a hallmark of photographic paper made after the 1950s, Lundgren says. Other manufacturing changes have not been well-documented, and much of that proprietary information is being lost as companies go out of business, Lundgren says. "It's important for us as connoisseurs of photography and as conservators who treat photography to understand those changes and when they occurred."

DART can even help conservators preserve digital prints. The paper for digital prints contains a "receiving layer" that helps the inks adhere. "If you use a paper from one company and an ink from another company, the print may be more likely to fade," Lundgren says. DART can help them characterize these proprietary materials.

In addition to their use as stand-alone techniques, these ionization methods could make it easier to interface mass spectrometry with planar separation techniques such as thin-layer chromatography. TLC separations can be monitored by simply placing the plate in front of the source. "You have an analyte ready to be analyzed on a surface," Van Berkel says.

Although these ionization methods are already being used for a variety of applications, scientists still want to understand the mechanisms better.

"You always want to know the basics: for controlling it better, for optimizing it, for pushing up the ion yield, for understanding which compounds get ionized and which are discriminated against," Zenobi says. The fundamentals could have practical im-



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plications. "It could be that there's a combination of experimental conditions that is a total sweet spot and no one has found it yet for some reason."

"It's very easy to rush and just work on the applications," Fernandez says. "We shouldn't lose sight of the fundamentals." For example, he says, knowledge of the energy transfer during ionization could lead to modifications in the sources that can ionize labile compounds without fragmentation or to improvements in ionization efficiency that enable analysis of low-concentration metabolites.

Information about the fundamentals is guiding technology development of DESI sources, according to Justin Wiseman, a scientist at Prosolia and one of the inventors of DESI. "We see a large need to understand better the chemistry that can happen at the surface to introduce new applications" of DESI, he says.

"Ultimately, our industrial customers want a tool to solve a particular problem and that has been our focus at Prosolia," says Kevin Boscacci, president of Prosolia. "However, understanding the fundamental aspects of the technique allows us to deliver the best product to meet this goal."

THE UNDERSTANDING of the DESI mechanism has improved greatly since the first report three years ago. At that time, Cooks and his coworkers proposed that the creation of analyte-containing charged droplets was a coulombic process. As they continue to study the DESI mechanism, they are finding instead that the process is almost purely physical.

Simulations show that desorption from the surface is actually based on momentum transfer, Cooks says. "The small solvent droplet hits a thin film on the sample surface, splashes against it, and creates a whole crew of progeny droplets," he says. At some point during this process, the charge is transferred from the droplet to the analyte.

"The DESI process is really the transfer of the compound on the surface into the liquid film and then its transport" in the tiny progeny droplets, Cooks adds. The film can even be a layer of the solvent stream itself. DESI, therefore, is turning out to be a micro- or even nanoextraction experiment, Cooks says.

The selectivity of DESI for particular sample components can be adjusted by using a different solvent or by adding new reagents to the original one, which is typically a mixture of methanol and water. For example, adding hydroxylamine to the solvent spray improved the signal-to-noise ratio of the mass spectra of anabolic steroids tenfold, Cooks says.

The ionization mechanisms for DART and ASAP are less well-understood, but McEwen suspects they use basically the

ing different structural information about the analyte.

Nevertheless, the methods certainly aren't perfect. Van Berkel believes a more complete understanding of interdependent factors like ionization selectivity, surface chemistry, and matrix effects will be required before these ionization methods are accepted for sensitive applications such as homeland security and food safety. An insufficient understanding of these factors can lead to two types of incorrect answers:

false positives, in which something is identified that is not really present, and false negatives. Although false positives can be inconvenient and can slow down screening, the selectivity of mass spectrometry or the use of tandem MS can eliminate them as a concern.

"The real problem is with false negatives. You let a bomb through. The food is poisoned, and you don't know it," Van Berkel says. "More fundamental understanding and experience will be required to judge these techniques in terms of false-negative rate for these critical one-off, quick-look-in-the-field analyses," he says.

The next step for an open-air ionization method is taking it into the field. "Putting anything in the field is a big challenge, but I don't think we're very far actually," Fernandez says. He and Zenobi both want to see these ionization sources on portable

mass spectrometers. Fernandez suggests that they could be used with ion-mobility spectrometers, as well, eliminating the need for a vacuum system.

Developing a DESI miniature mass spectrometer is a priority for his lab for the next two years, Cooks says. His group recently published its first paper in the area, describing how they coupled DESI to a portable mass spectrometer (*Anal. Chem.*, DOI: 10.1021/aco71114x).

Who knows what applications lie in the future for these ionization methods? The world is wide open. "We may have completely different uses for these techniques than the traditional analytical analyses we're doing now," Van Berkel says. "We're all doing the easy things. There will be whole new applications that we haven't even thought of." ■

PETER CUTTS PHOTOGRAPHY



same gas-phase ion-molecule chemistry common to APCI without the ion suppression caused by the use of solvents in the latter technique. McEwen has been able to ionize the same kinds of samples with ASAP as have been reported for DART and has produced nearly identical mass spectra. "You get the same results, so it has to be pretty close to the same analyte ionization mechanism," he says.

Cody uses cholesterol to demonstrate how ionization conditions affect the ions that are formed. "If you ionize cholesterol by DART with the conditions we've been using most of the time, you get M+H minus water, so it looks like cholestadiene," he says. In contrast, using fluorobenzene as a dopant in the plasma yields an M⁺ ion. "Now we have a way to form odd-electron ions," Cody says. Odd-electron ions result in spectra that can be compared directly with those in mass spectral libraries, which are based on electron ionization, another method that forms odd-electron ions. In addition, odd-electron and even-electron ions fragment differently, thereby provid-

DIAGNOSING DEGRADATION
Adams hopes that DART will help monitor the variety of materials in the Library of Congress' collection.

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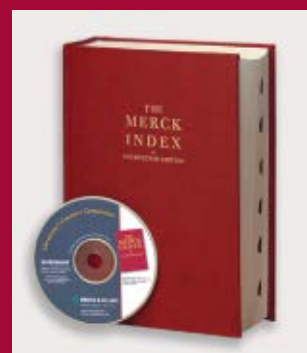
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ASAHI GLASS SHUTS NEW JERSEY PLANT

In an effort to improve earnings, Asahi Glass will close its fluorochemicals plant in Bayonne, N.J., at the end of the year. The plant, which produces polytetrafluoroethylene and fluorinated solvents, employs 157 people. Asahi has operated the facility since 1999, when it acquired ICI's fluoropolymers business. The Japanese firm will keep operating a plant in Thorndale, Pa., that compounds fluorinated resins. The Thorndale plant will obtain its raw material from Asahi plants in the U.K. and Japan.

MASCOMA TO PRODUCE SWITCHGRASS ETHANOL

Biofuels start-up Mascoma is joining with the University of Tennessee to build what it says will be the first U.S. plant to make ethanol out of switchgrass. The plant, to be located in Monroe County, Tenn., is expected to produce 5 million gal of ethanol per year by 2009. Tennessee's Biofuels Initiative will provide \$40 million for construction and \$27 million for R&D, including incentives for farmers to grow switchgrass. Mascoma is also planning to build cellulosic ethanol plants in Michigan and New York. Meanwhile, VeraSun Energy, one of the country's largest producers of traditional corn-based ethanol, says it is suspending construction on a new plant in Reynolds, Ind., due to a recent sharp drop in the price of ethanol.

CONOCOPHILLIPS, ADM STRIKE BIOFUELS DEAL

ConocoPhillips and Archer Daniels Midland will collaborate on research aimed at developing biocrude, a nonpetroleum substance derived from agricultural waste and forestry products that can be processed into transportation fuels. ADM, the biggest U.S. ethanol producer, will provide biomass from crops, wood, or switchgrass. ConocoPhillips, the nation's third-largest oil company, will convert the materials into biocrude, which will then be refined into gasoline, diesel, and jet fuel. Each company has committed \$5 million for research to be conducted over five years in their own labs as well as those of university-based partners.

TEIJIN BUYS STAKE IN CARGILL'S NATUREWORKS

Japan's Teijin has agreed to buy a 50% stake in NatureWorks, a Cargill subsidiary that produces plastics from corn sugar. Terms were not disclosed. NatureWorks operates a polylactic acid plant in Blair, Neb., with an annual capacity of 140,000 metric tons. The business was formed in 1997 as a 50-50 joint venture with Dow Chemical, and the partners completed the Blair plant in 2002 at a cost of about \$300 million. Three years later, Dow sold its share in the venture to Cargill at a loss, saying that environmentally friendly polymers do not appeal to consumers if they are more expensive than conventional ones. Teijin, one of Japan's largest producers of fibers and polymers, says it is investing in NatureWorks because it is committed to developing environmentally friendly chemical technologies. Last month, Total Petrochemical and Galactec announced that they would build a plant in Belgium for polylactic acid-based plastics (C&EN, Oct. 1, page 21).

CHEMICAL COMPANIES SUPPLY BOEING 787

Two chemical companies are shipping materials to Boeing for use in the new 787 Dreamliner. The plane will be insulated with Basotect, BASF's sound-absorbing and heat-blocking melamine resin foam. BASF says it worked with Boeing to develop a new version of the foam that is 30% lighter than the conventional material. PPG Industries, meanwhile, has delivered Boeing its first shipment of electrochromic shades, which replace pull-down shades on the plane's windows. A first for pas-

senger windows on commercial aircraft, the shades combine electrochromic technology from Gentex and metallic coating know-how from PPG.

AKZO SEES SYNERGIES IN ICI ACQUISITION

Akzo Nobel managers estimate that operating cost savings and other synergies from their acquisition of ICI's paints business will total nearly \$3.5 billion, after implementation costs. In a shareholder circular, the company confirmed that it intends to find a new owner for ICI's specialty starches business, while retaining ICI's specialty polymers business. Akzo Nobel expects to wrap up the \$16 billion purchase by Jan. 2, 2008. Akzo's \$15 billion sale of its Organon BioSciences unit to Schering-Plough should be completed no later than the end of this year.

BAYER, LANXESS SORT OUT ANTWERP SITE

Bayer and Lanxess, the industrial chemicals unit that Bayer spun off several years ago, are realigning their operations in Antwerp, Belgium, following Lanxess' sale of 51% of its styrenic plastics business to Ineos. Bayer plans to cut 155 jobs out of a current total of 900 from its polycarbonate plant in Antwerp. Meanwhile, Lanxess will reorganize its own operations in Antwerp in a move that will affect 127 jobs, most of



which will be transferred to external service companies. According to Lanxess, the Belgian site faces steep rises in energy and raw materials costs and strong competition from Asia.

PFIZER NAMES MACKAY TO HEAD RESEARCH

Pfizer has named Martin Mackay as president of Pfizer Global Research & Development. Formerly head of research and technology, Mackay replaces John L. La-Mattina, who announced his plans to retire in May, soon after Pfizer stopped development of its most promising drug candidate, the cholesterol treatment torcetrapib. In other R&D moves, Pfizer has launched a stand-alone biotherapeutics innovation center to be led by Corey Goodman, a scientist who cofounded the biotech companies Exelixis and Renovis. And the company has hired Briggs Morrison, formerly a high-ranking Merck & Co. R&D executive, to head clinical development.

BASF, LINDE, RWE PURSUE CLEAN COAL

BASF, Linde, and RWE Power plan to cooperate on a project to develop clean-coal technologies. Electric utility RWE says it will spend \$113 million on the project,

which will include a pilot facility at a coal-burning power plant in Niederaussem, Germany. BASF plans to test new solvents for the efficient capture of carbon dioxide; it has already carried out some work in developing novel amine-based solvents to absorb CO₂ from gasified coal. Linde will engineer and build the pilot facility. The project's goal is to come up with a commercial process by 2020 to remove 90% of CO₂ from combustion gas for injection underground. Last month, industrial gas concern Praxair and engineering firm Foster Wheeler said they were cooperating to develop clean-coal technology.

SONY TO LAUNCH FIRST OLED TELEVISION

On Dec. 1, electronics maker Sony plans to launch the XEL-1, a television it claims will be the world's first that is based on organic light-emitting diodes (OLEDs). The 11-inch color display will measure 3 mm at its thinnest point and will go on sale in Japan for \$1,700.



Flat-panel televisions today are based on either plasma or liquid-crystal display technology.

GE, LILLY PURSUE CANCER DIAGNOSTICS

GE Global Research and GE Healthcare will work with Eli Lilly & Co. to discover in vitro diagnostic assays that may predict patient response to certain cancer therapies. Under the deal, Lilly will provide GE with access to tissue samples from unidentified patients enrolled in clinical trials. "We hope to identify biomarkers for two of our targeted cancer therapeutic agents by examining patient tissues in order to determine which patients are most likely to respond to the medications," says Richard Gaynor, Lilly's vice president for cancer research.

AIR LIQUIDE ACQUIRES TWO SPECIALTY FIRMS

Air Liquide has reached agreements to acquire two specialty gases companies. The first, Scott Specialty Gases, is a supplier of gases for the medical, electronic, and analytical markets; it has 450 employees and annual sales of \$88 million. Air Liquide says the deal will accelerate its growth in the U.S. specialty gases business, where annual sales are about \$1.3 billion and are growing at 6% per year. The second acquisition is of Allied Healthcare, a U.K. supplier of home care and medical gases. Air Liquide is buying the firm for \$72 million.

BUSINESS ROUNDUP

DOW CHEMICAL will work with WaterHealth International to provide \$30 million worth of loan guarantees to support the financing of up to 2,000 community water systems in India. WaterHealth says the commitment will allow it to install more than the 3,000 systems it previously targeted.

EASTMAN CHEMICAL has exercised its option to purchase an idle methanol and ammonia facility in Beaumont, Texas, from Terra Industries. The plant will be downstream from a \$1.6 billion coal gasification complex that

Eastman is helping to construct in Beaumont.

SÜD-CHEMIE has agreed to sell its Nanofil business to Rockwood Specialties for an undisclosed sum. Nanofil products are organically modified bentonite clays that are added to plastics as flame retardants and barrier agents.

KONARKA, a firm developing polymer-based solar cells, has raised \$45 million in new financing from investors including Mackenzie Financial and Good Energies.

KEMIRA'S Water Solutions subsidiary will acquire Nheel Química, a

Brazilian water treatment chemicals company, for an undisclosed sum. In 2006, Nheel had sales of approximately \$34 million, generated from coagulants produced at its site in Rio Claro, São Paulo state.

ASAHI KASEI and Nippon Kayaku have agreed to merge their industrial explosives businesses into an equally owned joint venture with projected annual sales of \$85 million. The companies say the Japanese market for explosives has been declining.

RANBAXY Laboratories, India's largest drug company, will increase its

stake in Zenotech Laboratories to 45% from 7% today. Zenotech, an Indian company that produces injectable drugs, is developing generic versions of several biopharmaceuticals. Ranbaxy says the move positions it to participate in the emerging generic biologics market.

WYETH'S BOARD has elected Bernard Poussot as president and CEO, effective Jan. 1, 2008. Current chairman and CEO Robert Essner will remain in his job until then and stay on afterward as chairman for a transition period. Poussot is currently president and chief operating officer.

THERMO FISHER Scientific has acquired Priority Solutions International, a \$95 million-per-year company that delivers pharmaceutical samples and direct-to-physician drug supplies. Thermo says Priority fits with its biopharma services business, which delivers samples to patients participating in clinical trials.

PDL BIOPHARMA has put itself up for sale. The Redwood City, Calif., biotech company recently announced the elimination of 250 jobs, about a quarter of its workforce, following a halt in the development of Nuvion, for ulcerative colitis, due to poor efficacy.



MABCENT

LIQUID GOLD MINE

Scientists in **NORWAY** are plumbing the seas for the next blockbuster medicine

LISA M. JARVIS, C&EN NORTHEAST NEWS BUREAU

AS YOUR PLANE descends into Tromsø in the far north of Norway, you have the sense of touching down on another planet. Surrounded by mountains, the city of 60,000 is in fact a series of islands and fjords, an interplay of greens and blues that is eerily breathtaking on even the foggiest of September days. This is the gateway to the Arctic, a place that enjoys mid-night sun in the summer and the northern lights in the winter.

Head south through Bodø and Trondheim, and by the time you've made your way down to the capital city of Oslo, the fjords, rocky islands, mountains, and endless forests start to seem routine. Untouched beauty is just the way it is in Norway, and it's been that way for thousands of years.

It's easy to adopt the nonchalant attitude of Norwegians, who are almost blasé about the abundance of natural resources at their fingertips. Yet Norwegians also recognize that those natural resources are the lifeblood of their economy. Fishing and, more recently, offshore oil and natural gas drilling have made Norway a wealthy nation.

Norwegians are again looking to the seas for the next industrial wave: biotechnology. The plan is to tap into the therapeutic potential of novel compounds in the marine organisms found in the fjords and arctic waters off the country's craggy coast.

Aided by the government, universities, and a small number of industrial partners, scientists are launching a concerted "marine bioprospecting" effort. They have begun filing through the 4,000 marine invertebrates, 200 types of fish, 150 macroalgae, and 250 microalgae estimated to be thriving in Norwegian coastal waters. Throw in the high density of bacteria found in marine sediment, and suddenly, there's a lot to explore.

Bioprospecting is not a new concept. David J. Newman, chief of the Natural Products Branch of the National Cancer Institute (NCI), estimates that around

GONE FISHING
Marine biologist Robert A. Johansen takes samples from the Tromsø fjord.

60% of the drugs on the market today are derived from or designed to resemble natural chemical products. Some obvious examples are paclitaxel,

the breast cancer drug originally derived from the bark of the Pacific yew tree, or artemisinin, the malaria treatment made from the sweet wormwood plant. And many of the antibiotics we take were discovered in soil samples.

"The answer might be under your feet," quips Trond E. Ellingsen, biotechnology research director at Norway's Sintef, the largest independent research organization in Scandinavia. "It just depends on where you've walked."

EVEN THE NOTION of trawling the ocean for drugs has been around since the 1970s, though the focus has been on tropical waters. Scientists have long been intrigued by the extreme conditions that some marine organisms endure. In order to survive, they must adapt to a wide range of temperatures, changes in salinity, high pressures at great depths, and high concentrations of halogens, to name just a few obstacles.

Yet despite a growing pipeline, the only "direct-from-the-sea" drug on the market today is the chronic pain treatment ziconotide, approved in late 2004 and sold by Elan Pharmaceuticals under the brand name Prialt. Though made synthetically, the product is identical to a peptide found in the venom of cone snails. A few other products have marine life "in their DNA," as Newman terms it, most notably the HIV medicine azidothymidine, which is structurally related to a compound made by a Caribbean sea sponge.

But scientists are getting better at figuring out how to turn the discoveries of the sea into viable drugs, and interest in the field appears to be growing, particularly as fewer novel compounds are being found from terrestrial sources.

The Norwegians believe they have several advantages when it comes to mining the sea for pharmaceutical gold. For one thing, the circulation pattern off the Norwegian coast mixes cold water from the

"We're talking about organisms that have never seen temperatures greater than 5 °C."

Arctic with the warm water of the Gulf Stream, creating layers of temperatures that should encourage biodiversity.

For years, scientists thought there would be little diversity between global waters. They reasoned that the currents, not to mention the critters that cling to ships traveling far and wide, would ensure that the enzymes and other bioactive molecules found in the Arctic Ocean would be similar to those found, say, off the coast of Florida.

In fact, says Sergey B. Zotchev, a professor in the biotechnology department at the Norwegian University of Science & Technology (NTNU), in Trondheim, it is now understood that while a good portion of the microbes found in the ocean look similar, the secondary metabolites they produce differ widely. This is crucial to drug discovery and could give Norway another edge.

But perhaps the country's most important advantage is the element of the unknown: Quite simply, until recently, no one had bothered to look for drugs there.



NCI's Newman believes there is vast potential in the waters of Norway, be they the Arctic Ocean and Barents Sea off its northern coast or the fjords found throughout. "You have sources of invertebrates that nobody has looked at before," he points out. Furthermore, there is a huge range of bacteria with therapeutic promise living in those waters. "There are massive areas of the seabed and fjords where you can look for microbes that are marine in origin or have at least learned to coexist in the marine environment. The potential is enormous."

With billions of cells of bacteria per liter, salt water is a matrix of microorganisms struggling to survive, notes Geir Johnsen, a biology professor at NTNU who manages a research boat based in the Trondheim fjord. "When you are swimming in salt water, it's like swimming in spit," he says.

Researchers in Trondheim, which along with Tromsø is one of two hubs of marine bioprospecting activity in Norway, have been working since 2003

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LISA JARVIS/C&EN

BIOBANK Tromsø scientists are creating a database of local marine life.

and by sampling the larger organisms that hoard them.

to access the therapeutic usefulness of those bugs in two ways: by collecting seawater and sediment

turns out, is more sophisticated than it appears. A sponge the size of a soccer ball will soak up hundreds of liters of water every day in search of its next meal. But in addition to attracting tasty treats, it also captures and filters bacteria and other microorganisms. Some of those bacteria turn out to be beneficial to the sea

NTNU's Zotchev has chosen to focus on sea sponges. They are the simplest of animals but are engaged in constant biological and chemical warfare against those billions of microbes, which means their pores could be storing prime antibacterial drug candidates.

That natural sponge used to exfoliate your back, it

sponge, which then produces compounds that allow it and these guests to happily coexist.

Last year, Johnsen and Zotchev headed out on an expedition to harvest a range of sea sponges from the Trondheim fjord. Using cameras to monitor the seafloor, scientists directed a remotely operated vehicle to collect interesting sponges. On the boat, the sponges were cut into pieces, stored in seawater mixed with glycerin, which usually preserves the living bacteria, and later frozen to -80°C . Back at the lab, the pieces were ground with a mortar and pestle, put in suspension, centrifuged, and placed on culture plates.

And then Zotchev's group waited. "When you first try to grow these bacteria, it might take up to six weeks to appear," he notes. Also, it can be tricky to create the right conditions for growth; the genes within the bacteria that express the desired compounds need the right environment to be turned on, and scientists must figure out those triggers.

The samples are then subjected to

SUCCESS STORIES

From The Ocean To Patients

Marine bioprospecting, or panning for drugs in the sea, is an intriguing concept, but to date, it has yielded few actual therapies. More often, what it has done is help chemists translate the promise of nature into viable drug candidates. The stories of two marine-inspired products that are heading toward commercialization illustrate how scientists are learning to overcome past challenges.

PharmaMar, a Spanish company dedicated to probing marine sources for their cancer-fighting potential, is the closest to bringing a marine product to market. A drug the firm calls Yondelis is awaiting final marketing approval in Europe for treating advanced soft tissue sarcoma and is in a handful of Phase II/III studies in other cancers. Its active ingredi-

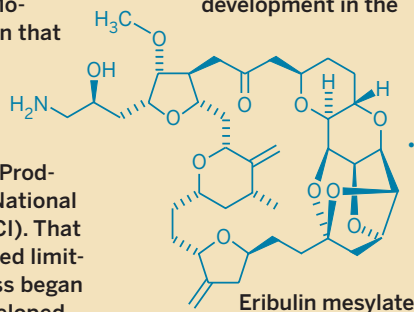
ent, trabectedin, is found in the filter feeder *Ecteinascidia turbinata*, more commonly known as a sea squirt.

PharmaMar originally set up an aquafarm in Morocco with the notion that trabectedin could be extracted from the organism, says David Newman, chief of the Natural Products Branch of the National Cancer Institute (NCI). That route, however, proved limiting, and real progress began when scientists developed a semisynthetic method to manufacture trabectedin using a bacterial precursor.

The other compound working its way through the pipeline is eribulin mesylate, an analog of halichondrin B, a macrocyclic polyether found in several kinds of sea sponges. Eisai Pharmaceuti-

cals recently initiated Phase III studies of the drug in advanced breast cancer.

It too has traveled a long road. Originally isolated in 1986, halichondrin B was shown to be active in fighting tumors in mouse models. After putting it into clinical development in the

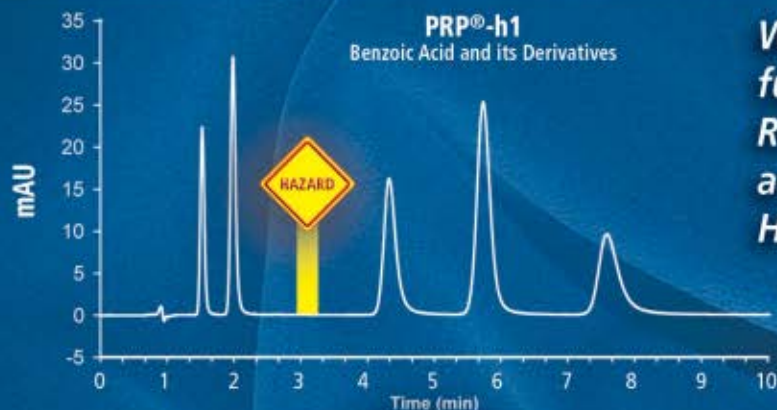


early 1990s, NCI funded the collection of 1 ton of the host sponge, which is found in deep water off the coast of New Zealand. That boiled down to a mere 300 mg of product, Newman recalls, not nearly enough to further develop the drug.

NCI subsequently enlisted Yoshito Kishi, a chemistry professor at Harvard University, to devise the total synthesis of halichondrin B. Kishi's group found that only the "ring half" of the molecule was needed for bioactivity and, working with Eisai, generated a range of analogs. That led to a cooperative program between NCI and Eisai, which in 2002 initiated Phase I trials of eribulin, an analog that displays more activity with less toxicity than halichondrin B.

"When we started doing this, there were not the synthetic chemistry techniques available on a large scale," Newman says. Even fermentation routes were limited, because researchers were hesitant to ferment in salt water. However, today, he says, "depending on the compound and the time frame, any and all of these routes are valid."

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high-throughput screening to see if there is an inkling of activity that could have medical or other commercial relevance. The screening is conducted with robotic systems shared by NTNU and Sintef, the independent organization that helps commercialize research coming out of Trondheim.

Yet even after screening, scientists might wind up with known antibacterial compounds. The risk of duplication is augmented by prospecting in the fjords, where some of what is found in the water may actually be run-off from the glaciers and surrounding land.

If scientists find a hit and want to scale up to investigate further, NTNU and Sintef share process development facilities that enable a researcher to make enough

material for preclinical trials. The labs boast fermenters ranging from 2 L up to 20 L and a pilot plant with 1,500-L vessels.

Zotchev plans to exploit the commercial potential of his sea-sponge pursuits by licensing promising hits through


manipulation to improve the molecules generated by bacteria, he expects that other techniques may be required to further develop those hits. Like many of the natural products found on land, a promising molecule may need to be modified



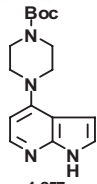
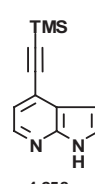
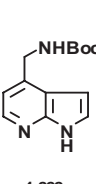
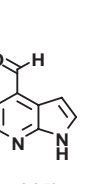
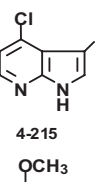
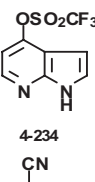
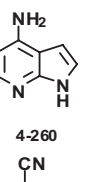
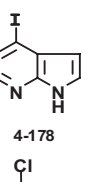
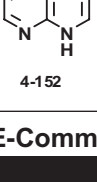
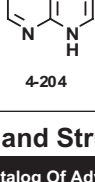
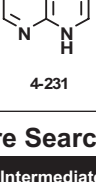
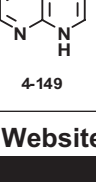
PRESERVING LIFE Zotchev (foreground) helps to categorize sea sponge samples found in the Trondheim fjord.

Biosergen, a company he founded in 2004 to develop analogs of the antifungal compound nystatin. So far, his research group, which is specifically interested in actinomycete bacteria, has identified more than 100 antibacterial and 33 antifungal hits, including some that they believe are new compounds.

Though he uses genetic

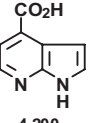
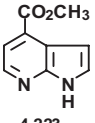
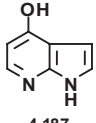
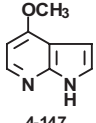



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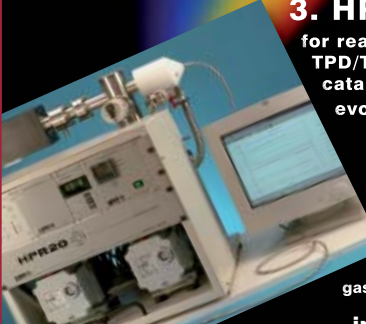
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to make a good drug candidate. As such, Zotchev has signed on with the contract chemistry firm ChemDiv, which is providing synthesis work.

Other research teams are focused on categorizing bacteria found in water collected from the fjord. A project led by Svein Valla, a professor in NTNU's biotechnology department, appears poised for commercialization. His team has developed a set of unique vectors that can insert genetic material into a broad range of hosts. Yet another project is focused on identifying pigments made by bacteria.

While the Trondheim scientists are focused on culturing bacteria found in seawater and sponges, researchers at the University of Tromsø are looking at anything and everything. They are attempting to create a "biobank" of the marine invertebrates, algae, and bacteria found in the arctic waters; search those organisms for useful compounds; and with the help of partners, develop the compounds into drugs or other commercial products.

THEIR PROJECT was officially launched in March with the formation of MabCent, the center for research-based innovation on marine bioactives and drug discovery. The University of Tromsø and the Norwegian Research Council, along with a small group of industrial partners, have provided the biobank program with \$25 million in funding over the next eight years.

MabCent hit the water running. In May, about 25 scientists packed onto a research boat for a 10-day bioprospecting trip in Svalbard, a group of islands midway between Norway and the North Pole. Undeterred by the occasional polar bear that would pop up out of the ice, they brought back a boatload of samples.

Their collection has been further expanded by sampling from the fjord in Tromsø, a local resource that researchers say should not be overlooked. All told, they have enough samples to keep them busy for at least 18 months, according to Trond O. Jorgensen, director of MabCent.

Thanks to the extreme conditions the marine life endures, the Tromsø scientists believe they could have some unique, highly active compounds in their collection. "We're talking about organisms that have never seen temperatures greater than 5 °C," Jorgensen says. The theory is that the active molecules within those creatures have, over millions of years, evolved to become highly selective for

their targets because synthesis is so slow in those conditions.

This selectivity means that cold-adapted molecules could make good drug candidates and could even prove to be efficient catalysts in industrial processes. Furthermore, they could enable "green" manufacturing because they are generally easy to inactivate: Just raise the tempera-

ture a bit and they turn off, says Kjersti Lie Gabrielsen, project manager for Marbank, which is responsible for the collection and preservation of MabCent's marine library.

The Tromsø scientists are extracting active molecules directly from the organisms, with the goal of obtaining between 100 g and a kilogram of material per organism. After the material is extracted

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and cataloged, it will be screened for molecules displaying antitumor, antibacterial, or immunomodulating properties, as well as for enzymes and enzyme-inhibiting activities.

With a lot of work ahead, MabCent expects over its eight years of funding to hire up to 35 marine biologists, chemists, biochemists, and other scientists. Hits

generated by the group will be passed off to industrial partners that will conduct further pharmaceutical studies. Partners also will come up with synthetic or fer-

“When you are swimming in salt water, it’s like swimming in spit.”

mentation routes to produce them on a large scale.

One Tromsø-based firm has already seen some success based on earlier bioprospecting activities. Biotec Pharmacon has commercialized uracil-DNA glycosylase, an enzyme found in Atlantic cod, for use in polymerase chain reaction experiments.

STILL OTHERS are poised to capitalize on MabCent’s biobank. Most notably, Lytix Biopharma, a Tromsø-based biotech firm, has signed a licensing agreement with the university that gives it access to the molecular diversity of the biobank. The firm will take hits in certain therapeutic areas from MabCent’s screens and then apply its peptide and small-molecule expertise to “add value,” says Oystein Rekdal, Lytix’ chief executive officer.

Although research is advancing and companies are being created, scientists in both Tromsø and Trondheim recognize that marine bioprospecting still faces challenges. For one thing, although a small cluster of oncology researchers is forming in Oslo, Norway is not known as a biotech hot spot, and support services are few and far between. Once research moves into the development stage, companies are largely reliant on contractors outside of Norway.

Also, some Norwegian researchers are frustrated that the government has not made the biotech industry more of a priority. Though the MabCent program in Tromsø has won an influx of cash from the government, funding in Trondheim has been harder to come by, and researchers are now turning to private, largely foreign, investors.

The funding situation is not helped by the inherent modesty of many Norwegian scientists, who seem content to let their marine bioprospecting efforts fly under the radar in the larger biotech community. Their lack of self-promotion may hinder their ability to attract financing and licensing partners, particularly from outside of Scandinavia.

Still, the opportunity appears to be as vast as the natural resources at the scientists’ doorstep. Given their motivation, Norway’s biotechnological promise may be limited only by the speed with which they can mine the country’s icy waters. ■

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DUPONT FINDS ITSELF

Company says it has **COMPLETED A TRANSFORMATION** from chemical maker to science firm

ALEXANDER H. TULLO, C&EN NORTHEAST NEWS BUREAU

LAST MONTH, DuPont hosted journalists from around the world at its eminent Experimental Station in Wilmington, Del. Companies usually hold such events to show off a new corporate identity or a major acquisition. Sometimes the excuse is an anniversary, as in 2002, when DuPont held its last major press conference to commemorate its bicentennial.

This time around the reason is a bit more subtle. DuPont believes that a gradual transformation, a decade in the making, is now falling into place.

If measured by merger and acquisition activity, the amount of change has been immense. From 1997 to 2004, the value of all of DuPont's divestitures, acquisitions, and new joint ventures totaled \$60 billion, more than twice the company's 2006 sales of \$27.4 billion.

The theme of the transactions was getting out of cyclical commodity businesses and getting stronger in growing, technology-driven ones. Prominent divestitures included the oil company Conoco and the Invista fibers unit. Noteworthy acquisitions included the seed firm Pioneer Hi-Bred International and electronic chemicals maker ChemFirst.

Charles O. Holliday Jr., DuPont's chairman and chief executive officer, told reporters that the scheme is working. He pointed out in his presentation that the company is bigger now than it was in 2001, before the sale of Invista, which, at the time, represented about 20% of the company's \$25 billion in sales. He attributes the subsequent sales increase to strong growth in its remaining businesses.

Those businesses include safety and protection, which makes products such as Kevlar; electronic materials; coatings and pigments; performance materials, including engineering plastics; and agriculture and nutrition, which houses the Pioneer seed business.

Holliday acknowledged that DuPont is

not as big as it would have been without the divestitures. The company was the world's second-largest chemical company in 2001, behind Dow Chemical. By 2006, it had slipped to number six (C&EN, July 23, page 13).

But Holliday shuns such rankings. "People measure the worth of a company in many ways," he said. "One can just be the revenue turnover. We made the decision a decade ago that that was not the most important measure. It would be easy just to



increase revenue turnover. We want to talk about value created."

And DuPont doesn't even consider itself a chemical company. Executive Vice President Ellen J. Kullman stated that DuPont's core business is "innovation and science." When asked by reporters what firms DuPont considers its corporate peers, Jeff L. Keefer, the firm's chief financial officer, mentioned 3M and Monsanto and even agreed with a comparison to industrial conglomerate United Technolo-

gies. "There are elements of our portfolio that are chemical-related, but we do not have the heavy-duty, ethylene-based petrochemicals that are really the backbone of Dow and BASF," he said.

Holliday's vision is for DuPont "to be the world's most dynamic science company." He said this means responding to customer needs "faster and better" than the competition does.

Another element of the vision is "sustainable solutions," which Holliday believes customers will increasingly demand. "We are in a resource-constrained world," he said.

Many of the technologies DuPont is developing address this constraint. The company is the largest supplier of materials other than polysilicon for photovoltaic cells, a market it says is growing 30% annually.

But the leading example of its sustainability efforts is probably biomaterials and biofuels. Earlier this year, DuPont started up a plant in Loudon, Tenn., with partner Tate & Lyle to make 1,3-propanediol from cornstarch.

That effort has led to work on biofuels. The company is developing a cellulosic route to ethanol with partners Novozymes and ethanol maker Poet. It also has a project with BP to make biobutanol. "We hitched our wagon to what we think are two new pieces of the biofuel equation, cellulosic ethanol and biobutanol," Holliday said.

Conventional bioethanol is made by fermenting corn-kernel-derived glucose into ethanol. In DuPont's cellulosic ethanol program, enzymes will break down corn stover, the leftovers of the corn harvest, into the sugars glucose and xylose. DuPont is developing a genetically modified *Zymomonas mobilis* organism, native to the agave plant from which tequila is extracted, to convert these sugars into ethanol.

"The cellulosic route to ethanol is a win-win," Holliday asserted. "We are taking a product that would just be plowed back into the field and has some value being plowed back into the field, but by properly collecting it and transforming it, we can increase the ethanol per acre." If only half the corn stover is processed, the amount of ethanol produced per acre can reach about 545 gal, the company says. Using only the kernels, an acre yields about 390 gal.

But DuPont says ethanol has its limitations as a fuel. It only has 66% of the energy content of gasoline, it is difficult to blend

A gradual transformation, a decade in the making, is now falling into place.

with other gasoline components, and it absorbs water. Butanol outperforms ethanol in all of these categories. BP and DuPont are building a biobutanol pilot facility in the U.K. and will eventually convert an ethanol plant to make the fuel.

The company says it also contributes to biofuels by developing seeds that boost agricultural production. The seed business has been problematic for DuPont, analysts say, but Citigroup's P.J. Juvekar says the company is turning it around with the introduction of new genetically modified seeds and better marketing. "DuPont, after losing market share to Monsanto for five years, seems to have kicked its efforts into high gear," he wrote in a recent report.

AMID THE CHANGE, the company says it isn't neglecting its more traditional businesses. For example, DuPont will spend \$500 million to expand capacity for its

Kevlar aramid fiber by 25% over the next three years. Kullman pointed out that there is more to Kevlar than bullet-proof vests. "The application you hear about the most is military," she said. But she notes that most of the growth the company is seeing in the product is in applications such as making lighter weight aircraft.

Another element of the transformation has been a change in how R&D is conducted. "We had focused on great research and less on the application," Holliday said. "We moved much more toward focusing on what the customer wants to buy and understanding the customer's needs and then internally putting the biologists and chemists together to find the answer." An example of the new approach is a new "innovation center," being constructed at the Experimental Station, that will house R&D and marketing personnel at the same location for the first time.

Thomas M. Connelly Jr., DuPont's chief innovation officer, explained that a "market back" approach yields better results than the "technology push" approach. "We can't leave our science in the laboratory," he said.

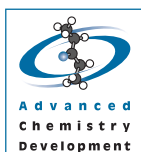
More transformation may be in DuPont's future. Keefer said the company may consider making big acquisitions again after a three-year hiatus. Cheap debt fueled a flurry of leveraged buyouts in the chemical industry, he explained, and made acquisitions too expensive for corporate buyers, but the recent tightening in the credit market puts DuPont in a better position. "There could be buying opportunities out there," Keefer said.

Although DuPont revealed much at the press event, it stayed mum on when the architect of its transformation will be ready to retire. Holliday has served as DuPont's CEO since early 1998, making him one of the longest tenured heads of a major chemical company. "Our mandatory retirement age is 65," he said. "I'm 59. I think we have a number of leaders who can be CEO tomorrow quite successfully. But I'm having too much fun to let them do it just yet." ■

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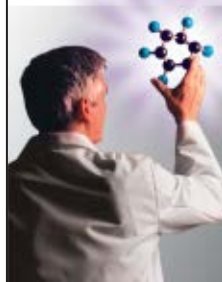
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WHY HELIUM IS IN SHORT SUPPLY

Maintenance disruptions, new **PROJECT DELAYS** mean shortages for at least two more years

WHEN HELIUM shortages hit the market last year, it was the party balloon business that first felt deflated. Since then, supplies of helium have gotten even tighter, pushing prices up and creating spot shortages for research, medical, and industrial users.

Just last month, Japanese gas suppliers Taiyo Nippon Sanso and Iwatani International told electronics industry customers to prepare for cutbacks of up to 30% in their normal helium supplies. In the electronics industry, helium is used to create an inert, clean environment.

Equipment failures, bad weather, and scheduled plant maintenance have all conspired to limit helium output. Meanwhile, significant new supplies from Algeria and Qatar have not lived up to expectations. Industrial gas companies say it will be at least two years before the shortages start to ease.

While helium is abundant in the universe, it is rare on Earth. A result of uranium and radium disintegration, helium is found in natural gas at concentrations ranging between 0.2 and 7% by volume. With a boiling point near -269°C , it is employed to cool the superconducting magnets used in the molecular analysis technique known as magnetic resonance spectroscopy and in nuclear magnetic resonance imaging equipment to diagnose disease.

Other properties including buoyancy, ionization potential, thermal conductivity, and nonflammability put helium in demand to fill dirigibles, weld metal, and cool optical fibers. As an element that exists as a single small atom, a stream of helium can be injected into machinery and other equipment to check for the tiniest leaks.

Most helium produced today is extracted from natural gas fields in the U.S. As gas production has declined, so has production of helium. Over the past few years, the U.S. government has helped supplement helium supplies by selling from reserves it maintains. But even the government sales, which now account for about one-

third of global supply, can't keep pace with increased demand. And the government expects to complete its sell-off by 2015.

THE LATEST CRIMP in the helium supply line developed when ExxonMobil told its customers that it plans to shut down its Shute Creek helium plant in southwestern Wyoming for maintenance. When that happens over a two-week period this month, a ripple will spread through the global helium supply chain. Taiyo Nippon communicated its warning to Japanese customers after learning of ExxonMobil's plans, says Phil Kornbluth, executive vice president of Matheson Tri-Gas, the U.S. subsidiary of Taiyo.

Taiyo gets a large portion of the helium it distributes from Shute Creek. Kornbluth estimates that this one facility alone accounts for about 20% of the global helium supply, which is roughly 175 million m^3 per year. With little inventory anywhere in the world, Japanese electronics customers are likely not the only ones to feel the impact.

Other crimps in the helium supply chain have been less predictable. The Bureau of Land Management, which is charged with selling government helium reserves, could not supply the noble gas when compressors failed for several days in the summer of 2006 and then again when severe weather interrupted power for several days early this year. "Supplies are so tight that it doesn't take much to get everyone twitching," says Leslie Theiss, who manages government sales out of Amarillo, Texas.

Theiss points out that storms at the start of the year interrupted power to major helium refiners in Kansas and Oklahoma, again stretching supplies. "We sometimes get calls from users asking us if we are re-

stricting supplies," Theiss says. "It's just not true. We are producing everything we are supposed to produce."

Major industrial gas suppliers, including Praxair, Air Products & Chemicals, and Air Liquide, are warning their customers to expect the shortages to continue. "The global helium industry supply-and-demand balance will continue to be tight for the foreseeable future," says John Van Sloun, general manager of helium and rare gases at Air Products. He adds that "new sourcing opportunities around the world are both scarce and slow to develop."

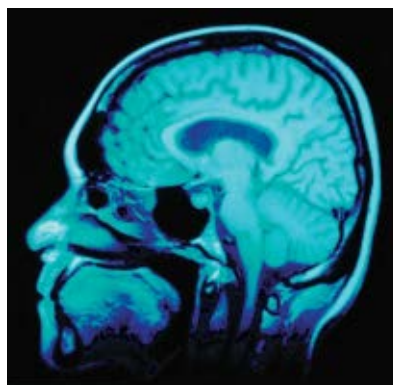
Jane Hoffman, global business director for helium at Praxair, estimates that helium demand grows at 5% a year. But because helium is a by-product of natural gas production, industrial gas firms can't simply build new helium plants. "We encourage the oil and gas guys to separate the helium from the natural gas they process, but ultimately, it is their investment to make," she says.

Hoffman and Kornbluth both point out that helium production is also dependent on the natural gas cycle. During winter, when demand for heating gas is strong in North America and Europe, more helium can be separated. In the summer and fall, when gas demand is low, less helium is available. Summer and fall are also the times of the year when many producers take down their helium facilities for maintenance.

Industrial gas producers are encouraging customers to bite the bullet and buy helium recycling units

to take some of the pressure off supplies. But recycling equipment is expensive, and recovery can be tricky, Hoffman explains.

However, until helium projects in Qatar and Algeria come up to speed and a project now under discussion in Russia comes online, this normally buoyant business will remain in the doldrums. "Helium will be tight at least through 2009, and our guess is that we won't have ample supplies again until 2011," Kornbluth says.—MARC REISCH



CHILLING DETAIL Helium cools magnets in MRI machines, making possible high-resolution anatomical images like this one of the cranium.

ARKEMA LOOKS AHEAD

At first investors' day, 'young' French company
CHARTS ROAD MAP through 2010

IT WAS IN MAY 2006 that Arkema was launched on the Paris stock market, completing its spin-off from the oil company Total. So with more than a year of business behind it, the company is looking ahead and setting its strategy through 2010.

With 2006 sales of \$7.4 billion, Arkema started life as one of the world's top 50 chemical players. As Chief Executive Officer Thierry Le Hénaff explained at the company's first ever investors' day last month, Arkema is present in more than 40 countries, has 17,000 employees, and operates six research centers in France, the U.S., and Japan.

The company has three business segments: 25% of sales last year came from vinyl products, 44% from industrial chemicals, and 31% from performance products. Operating earnings, Le Hénaff added, reflect the split pretty closely: 20% were from vinyls, 47% from industrial chemicals, and 33% from performance products.

Le Hénaff said he was pleased with his company's performance in the first half of this year. The vinyls business, in particular, benefited from strong demand for polyvinyl chloride and caustic soda and from restructuring measures. First-half operating profit margins rose to 8.1%, compared with 3.5% in first-half 2006.

Performance products, he said, benefited from good demand overall, despite tougher market conditions in functional additives. Its operating margin was 11.4% of sales, compared with 9.0% in first-half 2006. Only industrial chemicals fell, in part because of what Le Hénaff termed "challenging market conditions" in acrylics and fluorochemicals. The result: Operating margins were 11.2% in the half, compared with 12.2% a year earlier.

The first-half performance this year was good enough, in fact, that Le Hénaff forecast that the company's operating profits for the entire year would be up 20% over 2006; his initial target had been an improvement of 10–15%. Next year should be even better, he predicted, reflecting gains

from productivity, organic growth, and acquisitions.

For now, the French investment community seems to be willing to wait to see how the company progresses. Several analysts have put a "neutral" rating on the company.

Following the posting of second-quarter results in August, for example, UBS lowered its expectations for the firm's share performance. The results for the quarter slightly exceeded Arkema's forecasts, UBS analysts said, but overall prospects remained unchanged.

On the other hand, Denis Lantoine, an analyst with Internet-based investment advisers Investir.fr, sees enough promise in the company that his firm is buying Arkema shares. Lantoine thinks its stock could reach 55 euros per share—compared with about 43 euros today and a historic high close to 51 euros this past summer.

While the investment community waits, however, Arkema will be following "a clear path forward" to 2010, according to Le Hénaff. By then, the company will be "a deeply transformed" organization, focused on optimizing its costs, expanding its best industrial sites, divesting nonstrategic businesses, and acquiring other operations to strengthen core businesses.

He said Arkema wanted to acquire businesses with annual sales of anywhere from \$700 million to \$1.1 billion by 2010. Its first acquisition under this plan was the July purchase of acrylic polymers producer Coatex, which has sales running at the rate of about \$210 million a year.

ALSO HIGH on the agenda is strengthening operations in China. Le Hénaff emphasized the company's goal of increasing the share of its overall sales in Asia from 13% today to 20% by 2012.

The company already has fluorochemi-

cals plants at its site in Changshu, just northwest of Shanghai, and plans to expand operations there. At the investors' day, Arkema announced that it would build a polyvinylidene fluoride (PVDF) plant at Changshu by 2011. "Our decision to invest in China is based on the expanding Asian construction market and on our plan to grow the Kynar family of products into new construction and industrial applications," said Lando Ferretti, group president for technical polymers.

The PVDF project will provide Arkema with full manufacturing capabilities in the three main regions of the world, company officials said. Arkema already operates PVDF plants in France and in Calvert City,

Ky.; and an expansion of the Kentucky plant is scheduled for completion early next year.

The PVDF announcement came just three days after Arkema announced a partnership with Japanese fluorochemicals company Daikin to produce and market new-generation refrigerant fluids in the Asia-Pacific region.

The partners will create two joint ventures. One, the 60-40 joint venture

Arkema Daikin Fluorochemicals, will produce and market hydrofluorocarbon HFC-125. Arkema will provide its process and technological expertise for a "world-scale" plant in Changshu that is scheduled to open in 2010.

The other joint venture, the 60-40 Daikin Arkema Refrigerants Asia, will produce and market HFC refrigerant blends in Asia, in particular the R-410A blend of HFC-125 and HFC-32, which is intended as a replacement for hydrochlorofluorocarbon-22.

Le Hénaff also revealed that his company plans to double the size of a PVC heat stabilizer plant in Beijing, increasing capacity for organotin stabilizers to 12,000 metric tons per year. Set to open early next year, it will be the largest such plant in Asia, the company said.

The various projects will create a stronger Arkema in the future, Le Hénaff told investors. "I want to emphasize Arkema's rapid and in-depth transformation into a stronger group that is more coherent and more resilient to the economic cycles and has a genuine growth potential by 2010 and beyond," he said.—PATRICIA SHORT



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FINAL ATP AWARDS

The Advanced Technology Program, a Commerce Department grant program administered by the National Institute of Standards & Technology, has created 56 new awards for industrial research. These will be the final awards under ATP as the program was abolished by the 2007 America Competes Act, signed into law on Aug. 9. Only ongoing ATP projects and the 2007 competition will continue to be funded under the law. If all of the new projects are carried to completion, the new awards total \$138.7 million in ATP funds and an additional \$104 million in matching funds from industry. The funds will go to 69 companies and a nonprofit organization; 48 projects will be led by small businesses. ATP has provided cost-shared research support for high-risk industrial projects since 1990, but it has been heavily criticized by members of Congress over the years as providing wealthy businesses and corporations with unneeded federal funding. More information and brief descriptions of the new ATP projects can be found at www.nist.gov/public_affairs/releases/atp_2007_awards.html.

WHITE HOUSE HOLDS CLIMATE-CHANGE CONFERENCE

A White House conference on climate change, held on Sept. 27 and 28 with the world's major carbon-emitting nations, was supposed to show that President George W. Bush is serious about tackling climate issues, but other participants criticized his voluntary approach to the problem. "Energy security and climate change are two of the great challenges of our time. The United States takes these challenges seriously," Bush said in a speech at the State Department on the second day of the meeting. He proposed a summit next year of major CO₂ emitters to set a long-term global goal for reducing greenhouse gases. However, he repeated his position that the goal should be an aspiration, not mandatory, and that each country should design its own strategy for achieving the long-term goal. The European Commission, which represents 27 countries, expressed strong disapproval of the voluntary approach Bush advocates. A global reduction of 50% in greenhouse gases by 2050 "must be the absolute minimum effort ... to limit the risk of the global climate going beyond the famous 'tipping point' of no return," said Mogens Peter Carl, EC

SUPREME COURT URGED TO CUT HIGH DAMAGES AWARD

The American Chemistry Council is urging the U.S. Supreme Court to overturn a ruling by a federal court of appeals upholding \$17.5 million in punitive damages against Continental Carbon Co. in a pollution case. Last March, a three-judge panel of the Court of Appeals for the 11th Circuit in Atlanta affirmed a 2004 trial court decision that emissions of carbon black from Continental Carbon's Phenix City, Ala., facility caused discoloration and damage to property. The jury's \$20.7 million judgment in favor of four plaintiffs (including the City of Columbus, Ga., and a boat dealership) for surface staining included \$17.5 million in punitive damages, an amount ACC calls "grotesquely excessive." In an amicus brief, ACC contends the decision by the circuit court "exacerbates conflict and confusion in the lower federal and state appellate courts" over the meaning of guidelines established by the Supreme Court in 1996 for determining whether a punitive damages award is constitutionally appropriate.

director general for environment, at a conference press briefing. And to achieve this goal, he said, the developed nations that are responsible for 80% of the CO₂ already in the atmosphere need to make firm commitments to reduce emissions at least 30% by 2020 and 60–80% by 2050.

GLOBAL ACTION NEEDED FOR CO₂

A recent EPA analysis finds that none of three bills presently before Congress to reduce carbon dioxide emissions in the U.S. will make much difference without significant international action to cut the greenhouse gas. The bills (S. 1766, S. 280, and S. 485) would use different mechanisms, but they all call for 60–65% reductions in CO₂ by 2050 from a base year of 2006 in one case and 1990 for the other two bills. However, according to EPA, even if one of the bills becomes law, global CO₂ atmospheric concentration in 2095 would still be around 700 parts per million, only 25 ppm less than what would occur without controls. But if global actions were to be taken similar to those proposed for the U.S. in these bills, EPA says CO₂ levels would be around 490 ppm by 2095, placing them below the widely ac-

cepted international target of 550 ppm. Sen. Jeff Bingaman (D-N.M.), who was among senators calling for the analysis, said: "EPA's comparison shows that inaction is the real danger with regards to climate policy. The U.S. needs to address the problem of global warming as soon as possible if we hope to reduce the growth of greenhouse gas emissions around the world."

EPA APPROVES HCFC-22 REPLACEMENTS

Three chemical products received approval from EPA last week for use as replacements for hydrochlorofluorocarbon-22 in new and existing refrigeration and air conditioning equipment. Unlike HCFC-22, the three products do not deplete stratospheric ozone. They are greenhouse gases, however. EPA says their contribution to global warming will be minimized because the products fall under a regulation that prohibits them from being intentionally vented to the atmosphere. Two products, RS-45 and R-428a, are a blend of refrigerants, including several hydrofluorocarbons. The manufacturer of the third substance, called KDD5, claims the composition of the product as proprietary. EPA concluded that the three products do not pose an environmental or health risk greater than other substitutes for HCFC-22. Under the Clean Air Act, EPA must evaluate whether potential substitutes for ozone-depleting chemicals are acceptable for their intended uses.



Bingaman

COURTESY OF JEFF BINGAMAN

CONOCOPHILLIPS



TAX BREAK FOR BIOFUEL TARGETED

Credit for **FUEL FROM FAT** sparks fight on Capitol Hill

GLENN HESS, C&EN WASHINGTON

AN ATTEMPT BY some members of Congress to repeal the expansion of a federal tax incentive for producing alternative energy is threatening a joint venture announced in April by ConocoPhillips and Tyson Foods. The companies intend to produce "renewable" diesel fuel from animal fat such as beef tallow and pork lard. But without the tax credit, they argue, the process is not economically viable in the U.S.

A group of mostly Democratic House lawmakers, led by Rep. Lloyd Doggett (D-Texas), argues that the credit was established in the American Jobs Creation Act of 2004 to stimulate the growth of the fledgling biodiesel industry and its many small players, not to give major U.S. corporations another tax break. "Unless the abuse of this tax credit is prohibited, it will have the exact opposite effect of what Congress intended. It will discourage the creation of real renewable diesel fuel and all on the taxpayers' dime," says Doggett, a member of the tax-writing Ways & Means Committee.

A bill (H.R. 2361) introduced in May by Doggett and subsequently rolled into the broad energy package that easily passed

the House on Aug. 4 would overturn a ruling by the Treasury Department early this year that allows petroleum refiners to take advantage of a \$1.00-per-gal tax credit for producing diesel fuel from food wastes or vegetable oils in existing refineries.

Doggett insists that the tax credit was intended to encourage the production of fuel from purely renewable resources. "It was not intended to benefit oil companies that simply mix an undetermined amount of biomass into ordinary petroleum and call it renewable diesel," he asserts. Prohibiting the oil industry from taking advantage of a tax incentive that was meant for small biodiesel refiners, Doggett contends, "is a fiscally responsible way to prevent green energy initiatives from being converted into boondoggles."

The Senate, however, narrowly rejected an attempt to limit eligibility for the tax break when it passed its version of the energy legislation in June. House and Senate negotiators will try to reconcile differences

FAT FEEDSTOCK ConocoPhillips is fighting to preserve a subsidy for producing diesel fuel from animal fat at its refinery in Borger, Texas.

in their bills and resolve the tax dispute this fall.

ConocoPhillips, the nation's third-largest oil company, and Tyson, a major meat processor, plan to use Tyson's beef, pork, and poultry by-product fat to produce 175 million gal of diesel fuel per year by the end of 2008 at several ConocoPhillips refineries. Limited production is scheduled to begin before the end of the year at the company's plant in Borger, Texas, near Amarillo.

The two companies say the animal fat will be processed with hydrocarbon feedstock to produce a fuel that is chemically equivalent to petroleum-derived diesel and meets all federal standards for ultra-low-sulfur diesel. The processing technology was developed by researchers at Houston-based ConocoPhillips and was tested at the company's Whitegate Refinery in Cork, Ireland. Commercial production using soybean oil began in Ireland late last year. Tyson has access to about 2.3 billion lb of animal fat annually. The Springdale, Ark.-based company says the venture will use more than half of the fat that it currently sells as a commodity.

BUT THE DEAL depends on the companies' access to the \$1.00-per-gal tax credit that will make the fuel cost-effective. "Thanks to tax incentives, renewable diesel's retail price will be competitive at the pump," ConocoPhillips Chairman and Chief Executive Officer James J. Mulva remarked in announcing the joint venture in April. "It's not profitable without the \$1.00 tax credit. It's very important in going forward at this point in time."

ConocoPhillips and Tyson maintain that incentives are necessary to spur production of alternative fuels and help reduce the nation's dependence on foreign crude. "Our initiative is about increasing the supply of renewable fuels and contributing to U.S. energy security efforts," says Tyson spokesman Gary Mickelson. "We believe our alliance qualifies for a federal production tax credit."

The incentive was modified two years

"This is a question about what makes sound energy policy."

ago when Congress added a provision to the original biodiesel tax credit to include a chemical process called thermal depolymerization. TDP is a new technology that uses heat and pressure to turn food wastes into a boiler fuel. The provision was inserted into the Energy Policy Act of 2005 by then-House Majority Whip Roy Blunt (R-Mo.) to help a plant in his home district produce fuel from turkey carcasses.

After the legislation was enacted into law, ConocoPhillips and Tyson began lobbying the Bush Administration to rule that the tax credit could also apply to diesel fuel production that uses TDP technology to coprocess animal fat or other biomass with hydrocarbon feedstock. The companies argued in several meetings with White House officials that their process qualifies for the credit under Rep. Blunt's provision and is consistent with President George W. Bush's goal of boosting production of renewable fuels to combat the country's dependence on foreign oil.

"We wanted to get some certainty around the economics," says Louis Burke, manager of alternative energy programs

for ConocoPhillips. "The feedstock cost is substantially more than what the fuel sells for, so there's no economics at all if it doesn't get tax supported." Burke says

oil in a diesel hydrotreater. It doesn't quite work that way. You've got a whole lot of unit conversion work."

In a letter to Treasury Secretary Henry



COURTESY OF ROY BLUNT

Blunt

ConocoPhillips plans spend up to \$100 million over the next three to five years to enable several of its refineries to produce the new fuel. "This is a very difficult thing to do," he remarks. "Everyone seems to think you just dump animal fat or vegetable



NATIONAL BIODIESEL BOARD

Jobe



COURTESY OF LLOYD DOGGETT

Doggett

M. Paulson Jr. last September, Blunt urged the department to rule against the effort to expand eligibility for the tax credit. "My intention in enacting this provision was to provide a credit for a new class of technologies for the production of alternative fuels, which would utilize the whole waste stream of the biomass defined in the provision," Blunt wrote. "Interpretations that would allow credits to large unintended producers ... would require a substantial legislative policy change that far exceeds current law and could be very expensive in terms of potential revenue loss."

The tax break was initially projected to cost the government about \$46 million. But with ConocoPhillips claiming the credit, the added cost would start at \$175 million based on the company's plan to produce 175 million gal of diesel fuel. The expense could skyrocket if other companies that are openly exploring bioenergy possibilities, like Smithfield Foods, launch similar ventures.

Over Blunt's objections, the Internal Revenue Service (IRS) ruled, in a notice published on April 2 and designated as Notice 2007-37, that fuel produced by coprocessing biomass and petroleum feedstock is eligible for tax-favored treatment under the 2005 energy act. Andrew DeSouza, a spokesman for the Treasury Department, says the IRS ruling reflects a desire by the Administration "to incentivize the growth of alternative energies and alternative and renewable fuels." The tax break is due to expire at the end of 2008.

The IRS ruling and the ConocoPhillips-Tyson venture announced shortly

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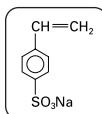
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thereafter have raised the ire of small biodiesel producers, who say they will not be able to compete if large petroleum refiners are able to claim the \$1.00-per-gal tax credit. "It's our belief that this credit was developed to help a specific emerging technology and not to further subsidize existing petroleum refineries," says Joseph Jobe, CEO of the National Biodiesel Board (NBB), a Jefferson City, Mo.-based industry trade association.

Allowing oil companies to claim a tax credit for converting biomass into diesel fuel at existing refineries "will do nothing to expand our nation's renewable production capacity and will hinder the growth of America's biodiesel industry," Jobe declares. "This is a question about what makes sound energy policy," he adds. "Do you take limited taxpayer dollars and invest them in new energy companies and technologies built from the ground up, or do you take those same dollars and give them to already large, mature, highly profitable oil companies?"

There are now 165 biodiesel plants operating throughout the U.S., according to NBB. Domestic production has increased from 25 million gal in 2004 to more than 250 million gal in 2006. Output is expected to exceed the 300 million-gal mark this year. But Jobe fears that large oil companies will put a stranglehold on the raw materials used to make biodiesel by artificially inflating feedstock costs. "The price of all vegetable oils and animal fat will be bid up, and eventually, it won't be economical to make biodiesel," he says. "Some plants are likely to go out of business, and the growth of the industry will be stunted."

Jobe stresses that the oil industry should not be painted with one broad brush. "We are talking about just a few companies that are engaged in this activity with respect to renewable diesel," he says. "Many segments of the petroleum industry, especially on the distribution side, have embraced biodiesel and supported its growth."

ConocoPhillips' Burke maintains that biodiesel refiners are fearful of competition from a second-generation product that offers a number of environmental advantages. Renewable diesel, for which

petroleum remains a primary ingredient, is cleaner burning, produces less nitrous oxide, and has lower sulfur content, he says. And unlike biodiesel, which must be transported by truck or rail, renewable diesel does not absorb moisture, so it can be transported through the existing pipeline distribution system. "The beauty of this product is that its system fully integrates downstream," says Burke. "If you want to do biofuels on a really big scale, such as tens of billions of gallons, you have to fit within the existing infrastructure, or it will not work."

THE EXPANSION of the tax credit has also angered soap and detergent makers, who rely on tallow-based oleochemicals to make cleaning products. In the U.S., fatty acids and other oleochemicals are primarily derived from beef tallow, a natural fat extracted from cattle.

"Although unintended, subsidies for biofuels are threatening the continued existence of the U.S. oleochemical industry," says Dennis Griesing, vice president of government affairs for the Washington, D.C.-based Soap & Detergent Association. "Ironically, a historically green industry is facing elimination by the subsidization of a new one. We believe that both can and should coexist as well as thrive."

Oleochemical producers were already under cost pressure because steeply rising corn prices, driven by the federal requirement to increase fuel ethanol production, have prompted farmers to switch to tallow and other less expensive ingredients for their livestock feed. The drawdown of the tallow pool has boosted prices into the range of 27-31 cents per lb in recent months, compared with only 15 cents a year ago. The type of operation announced by ConocoPhillips and Tyson poses an even greater challenge, Griesing says, because "it directly threatens the availability of tallow, not just its price."

It's estimated that the ConocoPhillips-Tyson venture could consume as much as one-quarter of the total U.S. beef tallow supply. Griesing says a few more similar ventures could gobble up all of the key feedstock. "There is no real elasticity in

"If you want renewable fuels, there are going to be a lot of unintended consequences. It is a feedstock-limited world."

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“The feedstock cost is substantially more than what the fuel sells for, so there’s no economics at all if it doesn’t get tax supported.”

the tallow supply,” he notes. Production is relatively fixed, usually fluctuating less than 2% from year to year. Cattle herds are not expanded to produce tallow; it’s a by-product. “If tallow becomes unavailable, the oleochemical industry will be lost to producers in Southeast Asia, and the U.S. will lose yet another traditional industry,” Griesing says.

Burke expresses sympathy for the soap makers, but he says the government’s fuel subsidies are altering markets and creating problems for a lot of companies. “I understand the concerns of the folks in the soap and oleochemical businesses,” he remarks. “The feedstock concerns about taking a triglyceride and turning it into fuel are legitimate. But if you want renewable fuels, there are going to be a lot of unintended consequences. It is a feedstock-limited world.”

ConocoPhillips and Tyson officials say

they will work hard to save their tax credit when House and Senate negotiators meet in a conference committee to hammer out a final energy bill. “Denying the tax credit will only serve to limit the expansion and availability of alternative fuels and also damage the ability of livestock farmers and ranchers to participate in the renewable energy business,” says Tyson’s Mickelson.

HE NOTES THAT a number of livestock producer groups, including the National Cattlemen’s Beef Association, National Pork Producers Association, National Chicken Council, and Texas Cattle Feeders Association, support Treasury’s position on the tax break for producing diesel from renewable feedstocks. “Our nation needs a diverse base of new energy sources. That’s why it makes sense for our government to give emerging energy technologies and processes equal treatment,” Mickelson says.

Burke argues that without the full \$1.00-per-gal subsidy, it would be impossible to make the new fuel in the U.S. without losing money. “If you do not have parity on the processing—say biodiesel gets a buck and we get 50 cents—they win, because I can’t afford the feedstock. If there’s a 50-cent-a-gal difference, we can’t compete with them economically,” he says. “So we hope to see the tax credit maintained.”

While the oil industry has been sharply criticized for not doing enough to promote the use of renewable energy, Burke says many members of Congress simply do not want to see oil companies get a tax credit. “They do not think the oil companies should get any help,” he says. “But they also tell us we should be doing biofuels work. Except you can’t do biofuels work without some form of tax support. We find the inconsistencies frustrating.” ■

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A Close Look At War

Ken Burns film tells hard and brutal tales from World War II
and raises a host of **PERSONAL MEMORIES**

MICHAEL HEYLIN, C&EN WASHINGTON

BORN AN ENGLISHMAN, I was a little put off by the first episode of “The War,” the seven-part film on the biggest conflict in human history by Ken Burns, the U.S.’s most esteemed documentary filmmaker. It is now being shown on public television.

My feelings toward the episode were due to its one-sentence dismissal of Britain’s lone stand against the Axis powers from the fall of France in June 1940 until Hitler invaded the Soviet Union one year later.

If Britain, too, had fallen in 1940, world history for the past 67 years would have been immeasurably different. With Britain out of the way, Hitler would have been free to attack the Soviet Union sooner than he did and with all his forces. He could well have succeeded.

This would have left the U.S. with an awful choice: Remain in isolation and tolerate a triumphant Hitler or try to defeat him with no major ally, no forward base, and with a rampant Japan to the rear.

The next episode, however, convinced me of Burns’s wisdom in not trying to produce a comprehensive history. What Burns and codirector Lynn Novak have produced is a telling of the battle front and home front experiences, not of generals, policymakers, and statesmen, but of ordinary citizens. They are from four small American cities that were heavily involved in the war effort—Luverne, Minn.; Mobile, Ala.; Sacramento, Calif.; and Waterbury, Conn.

This approach cost Burns. He was harshly criticized for not originally including stories from Hispanics. He later inserted about a half hour of such coverage. He also had to worry about the words often used by veterans that are now considered too dirty to broadcast.

Be that as it may, “The War” is an insightful account of what men do in war and what it does to them. On the home front, it is an intimate analysis of how the war affected every household. In both cases, it is a warts-and-all report.

The film claims not to glorify or sentimentalize the conflict. On the home front, it tells of an almost universal commitment to the war effort, as well as of some of the darker sides of that effort. On the battle front, the message hammered home is that combat is confusing, heroic, terrifying, extremely bloody, traumatic, inhumane, mind altering, and usually not well-planned. Combat is, indeed, unmitigated hell.

Watching “The War” is not easy. It lasts a total of 15 hours and is only up to episode five as I write

this. It is a very heavy story. In addition to detailing the incredible hardships of combat, “The War” also shows a lot of bodies, especially of U.S. soldiers and marines.

Burns’s saga also features extensive comments by veterans involved in some of America’s military setbacks. One is the mauling of the U.S. Army by German forces in its first major ground action of the war. That was at the Kasserine Pass in Tunisia. Another is the two largely unsuccessful air raids to knock out German ball-bearing production.

On the home front, the film probes the ethnic cleansing of the West Coast of those of Japanese ancestry, many of whom were U.S. citizens; the almost total racial segregation of the U.S. military; and the lethal racial tensions in war factories.

BUT MANY of the memories are positive. Almost all are of families contributing to the war effort in some way or another and giving support to their loved ones in the military. There

is also the constant concern for those in combat and the fear of the dreaded War Department telegram.

All of this revived my memories of World War II. Born in 1930, I was too young for combat. I lived in the eastern outskirts of London. I remember listening to Winston Churchill’s radio addresses. I experienced firsthand the Battle of Britain and the blitz of German air attacks on London in 1940. Later, I watched cruise missiles fly over my home and saw ballistic missiles strike nearby.

I was not traumatized. Millions fared much worse. None of my family was killed, and we were never separated. Our home was damaged but not destroyed. My sister and I were always able to attend school. Everything was rationed. Food was not plentiful, but nobody starved.

If war did not traumatize me, it was nevertheless my early formative life experience. What I took from it in the light of the chaos of war that I witnessed is to be cautious of all authority.

It eventually caused me to become a journalist. It formed my conviction that the primary goal of journalists should not be to be loved by their readers. It must be to earn the respect and trust of readers with stories that are consistently relevant, informative, and credible. This is what I have been striving to do for the past 44 years working for C&EN.

Views expressed on this page are those of the author and not necessarily those of ACS.



SHUTTERSTOCK

The primary goal of journalists should not be to be loved by their readers. It must be to earn the respect and trust of readers with stories that are consistently relevant, informative, and credible.



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BRANCHED POLYMERS VIA GRUBBS CATALYST

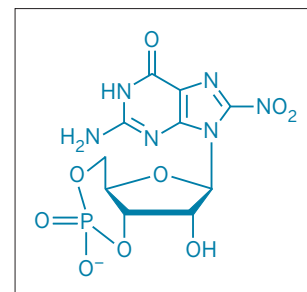
Using an olefin metathesis reaction and starting with easily synthesized monomers, Irina A. Gorodetskaya, Tae-Lim Choi, and Robert H. Grubbs at Caltech have synthesized hyperbranched polymers under mild conditions (*J. Am. Chem. Soc.*, DOI: 10.1021/ja0759040). Hyperbranched polymers have a number of properties that make them more attractive for industrial applications than their linear analogs, including multiple end groups, better solubility, and differing viscosities. Dendrimers are an example of useful, symmetric, and monodisperse hyperbranched polymers, but their notorious reputation for labor-intensive and expensive syntheses often precludes their use. Other hyperbranched polymers demonstrate properties similar to dendrimers, but their syntheses require complicated monomers and harsh conditions. The Caltech researchers used a ruthenium catalyst (Grubbs second-generation catalyst) to initiate the acyclic diene metathesis polymerization. Monomers functionalized with two or more acrylate groups and one terminal olefin provided branched structures, which were confirmed by nuclear magnetic resonance spectroscopy and size-exclusion chromatography.

NOVEL N-H INSERTION YIELDS AMINO ACIDS

Insertion of one reactant into a C-H bond of another reactant to form a chiral product is a valuable method in organic synthesis. The corresponding reactions involving X-H bonds, in which X is a heteroatom such as oxygen or nitrogen, have been much slower to develop. Last year,

NEW NITRIC OXIDE MESSENGER

Nitric oxide mediates myriad physiological processes, including blood vessel dilation and immune response. Though most NO signaling relies on the messenger molecule guanosine 3',5'-cyclic monophosphate (cGMP), NO sometimes exerts its effects by other pathways, not all of which are completely understood. Now, Takaaki Akaike of Kumamoto University, in Japan, and colleagues report 8-nitro-cGMP (shown), a newly confirmed offshoot of cellular NO production (*Nat. Chem. Biol.*, DOI: 10.1038/nchembio.2007.33). Despite a strong resemblance to cGMP, 8-nitro-cGMP has unique signaling roles because the NO₂ group confers distinct properties. For example, the electron-poor molecule reacts with the thiol in glutathione and in a redox-sensor signaling protein. These interactions swap the NO₂ group for an SH group, tagging the substrates with cGMP. This reaction is a novel post-translational modification the researchers call S-guanylation. The team thinks that its discovery further illuminates the downstream effects of NO and could be relevant to studies of NO-linked biological responses and diseases.



insertions, merging aryldiazo esters into carbamates (represented as RNH₂) to generate α -amino acids as shown (*J. Am. Chem. Soc.*, DOI: 10.1021/ja074483j). The new reaction, which complements two other recent examples of N-H insertions, could become a pathway for producing enantio-enriched amino acids, they note.

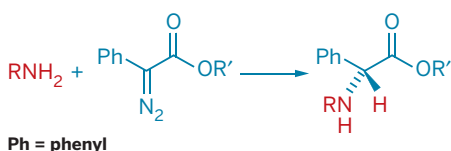
TREE BARK COMPONENT PROTECTS NEURONS

A derivative of a traditional Chinese cancer treatment obtained from tree bark prevents neuronal cell death, or apoptosis, according to a new study by researchers at Emory University School of Medicine (*Proc. Natl. Acad. Sci. USA*, DOI: 10.1073/pnas.0706662104). Gambogic amide, a multiring compound with alkenyl side chains, could become a treatment for stroke and neurodegenerative diseases. The compound, derived from resin of the *Garcinia hanburryi* tree, provides protection by mimicking the behavior of nerve growth factor (NGF). When NGF docks to a receptor called TrkA, it causes the receptor to dimerize, thereby triggering a cascade of cell-signaling events that prevent apoptosis. Keqiang Ye and coworkers found gambogic amide while screening for small-molecule compounds that bind TrkA. Gambogic amide is able to do many

of the things that NGF does, including initiating TrkA dimerization and tyrosine phosphorylation. In addition, gambogic amide triggers the growth of neurites, which are projections from the developing neuron's cell body.

β -PEPTIDES SYNTHESIZED BY WAY OF ENZYMES

Researchers have used enzymes for the first time to couple β -amino acids to other β -amino acids and to peptides. β -Amino acids have backbones one carbon atom longer than those of familiar α -amino acids. They are of interest as elements of β -peptides, which are oligomers that resist enzymatic breakdown and therefore have potential as oral drugs. Earlier this year, Dieter Seebach of the Swiss Federal Institute of Technology, Zurich, and coworkers found a new genus of microorganisms that possess peptidase enzymes that cleave β -amino acids from the N-termini of peptides. Now, Seebach and colleagues have used the reversible enzymes to join β -amino acids and to attach β -amino acids to peptides (*Chem. Biodiv.* 2007, 4, 2016). Use of the enzymes could have advantages over chemical techniques for β -peptide syntheses, such as improved regio- and stereoselectivity, reduced need for protecting groups, and mild reaction conditions.



MIT's Gregory C. Fu and Thomas C. Maier reported the first efficient method for catalytic enantioselective insertions into O-H bonds, which involved merging aryldiazo esters into alcohols to form α -hydroxy carbonyl compounds. Using similar chemistry, Fu and Elaine C. Lee, also at MIT, now have moved on to enantioselective N-H

HAPPENING HAFNIUM

Once obscure transition metal is now garnering attention as a potential **SUPERSTAR CATALYST**

STEPHEN K. RITTER, C&EN WASHINGTON

TITANIUM AND ZIRCONIUM have traditionally dominated group 4 chemistry. Hafnium, the third member of this group of early transition metals, has been the odd element out. But not anymore.

Steady progress in revealing hafnium's secrets during the past decade, including several key findings made this year, has the chemistry community taking notice of hafnium's potential capabilities as a catalyst to advance N_2 and C–H activation reactions.

Christoph Marschner, a chemistry professor at Graz University of Technology, in Austria, describes hafnium's foray "into the limelight" in a recent commentary (*Angew. Chem. Int. Ed.* **2007**, *46*, 6770). As an element, hafnium is a latecomer to the periodic table, Marschner writes. Titanium and zirconium were discovered in the late 1700s, but hafnium was not proven to exist until 1923. Marschner chalks up the belated discovery to the close resemblance between hafnium and zirconium. The metals are nearly identical in their physical and chemical properties, and hafnium accompanies zirconium in its minerals.

"If the chemistry of hafnium and zirconium are compared, it seems that the heavier hafnium, similar to the situation with the siblings palladium and platinum, imitates zirconium in a sluggish way," Marschner observes. For this reason, chemists have taken a while to uncover the subtle differences that can be exploited between titanium, zirconium, and hafnium. One of these differences, stemming from hafnium having a layer of f electrons in its electronic structure, is that hafnium participates more strongly in σ bonding with ligands, Marschner explains. This property endows hafnium with a slight edge in mediating certain types of chemical reactions.

Converting N_2 directly into value-added chemicals such as amines or heterocycles could be one of them, write Michael D. Fryzuk of the University of British Columbia and Yasuhiro Ohki of Nagoya University, in Japan, in another commentary about hafnium (*Angew. Chem. Int. Ed.* **2007**, *46*, 3180).

Such conversions could circumvent the energy-intensive Haber-Bosch process, a long-sought goal for the chemical industry. This workhorse reaction, requiring heat, pressure, and a heterogeneous iron catalyst, converts N_2 to ammonia, which is used to make nitrogen-containing compounds. So far, a homogeneous catalytic process run under mild conditions for this reaction remains elusive, despite dozens of known transition-metal N_2 complexes as starting points, they note.

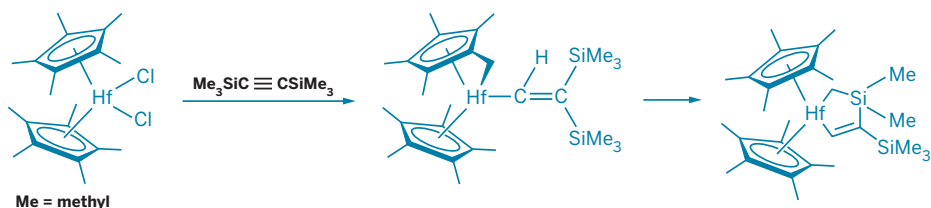
ONE RECENT EXAMPLE of hafnium-based N_2 activation that has chemists abuzz comes from Cornell University's Paul J. Chirik and coworkers. Chirik's group has shown that group 4 metallocenes—complexes in which the metal is sandwiched between cyclopentadienyl ligands—can be coaxed to preferentially bind N_2 . Dinitrogen generally is not a good ligand, but it can coordinate to transition

complexes react with H_2 to form a hydrazine core, N_2H_4 , between two metallocene units. These complexes release small amounts of ammonia, suggesting that they are facilitating the desired N_2 reduction to ammonia. The reactions aren't catalytic, but Chirik's group has shown that the hafnium complex reacts about four times faster than the zirconium complex. Chirik recently reviewed his group's work in this area, including discussing plausible reaction mechanisms, in a perspectives article (*Dalton Trans.* **2007**, 16).

"It is remarkable that the only dinitrogen complexes to date that result in N–H bond formation by reaction with H_2 are systems based on group 4 metals," Fryzuk and Ohki write. And although hafnium has been a less frequent participant in N_2 activation because it's the most difficult group 4 metal to reduce, it offers a broader range of reactivity patterns compared with zirconium, they add.

An example of hafnium's broader reactivity is Chirik's demonstration that reaction of the dihafnocene- N_2 complex with CO_2 leads to double insertion of CO_2 into the Hf–N bonds to form a N_2 - CO_2 core (*Angew. Chem. Int. Ed.* **2007**, *46*, 2858). Addition of Me_3SiH (Me = methyl) to the compound liberates N_2 - CO_2 by forming the stable dicarboxyl hydrazine $(Me_3Si)_2N-N(CO_2SiMe_3)_2$ mixed with iodinated haf-

TANDEM ACTIVATION Multiple Si–C and C–H activations lead to an intermediate in which the hafnium atom bonds with its own cyclopentadienyl methyl group (center). This complex further stabilizes through an additional C–H activation to form a metallacyclic ring (right).



metals in several ways, including end-on to one metal, side-on bridging two metals, or a combination of those two modes. Chirik's complexes bind N_2 side-on between the metal atoms of two metallocene molecules.

The usually tight $N=N$ bond is a little longer and weaker in the coordinated side-on complexes, giving the bound N_2 some imido-like qualities. This bonding interaction opens N_2 to attack and functionalization by electrophiles such as H_2 and hydrocarbons.

Chirik and coworkers reported last year that hafnocene- N_2 and zirconocene- N_2

nocene, which can be recycled.

It's not so much that hafnium is more reactive than zirconium or titanium, Chirik notes, but that it's more reducing, which means hafnium will do whatever it can to stay in the higher Hf(IV) oxidation state, including forming unusual complexes. "That's why, in part, our chemistry works," Chirik says.

Fryzuk and Ohki point out that Chirik's reactions have expanded the kinds of transformations possible with coordinated N_2 . Although chemists aren't much closer

to developing the highly sought catalytic cycles involving N_2 , they add, “optimism for further advances in N_2 functionalization remains.”

In other hafnium chemistry, Uwe Rosenthal of the University of Rostock, in Germany, and coworkers have shown that the metal can mediate never-before-seen Si–C and C–H activation reactions.

Rosenthal’s team has been exploring group 4 metallocene reactions with acetylenes for several years. The group quickly met success in forming adducts between bis(trimethylsilyl)acetylene ($Me_3SiC\equiv CSiMe_3$) and titanocene and zirconocene. The $C\equiv C$ bond coordinates side-on with the metal to form a three-membered ring, with each carbon retaining a trimethylsilyl substituent. But for hafnium, the research team ran into a wall when the adduct failed to form under the same reaction conditions.

BY TWEAKING the reactants to include a different reducing agent in a more inert solvent, Rosenthal’s group finally produced the hafnium adduct (*Organometallics* **2007**, 26, 247 and 3000). In doing so, the team made an interesting discovery of an alternative reaction pathway to a side product. This reaction, not observed for titanium or zirconium, has added to the growing interest in hafnium.

Besides forming the expected acetylene adduct, reaction of decamethylhafnocene with $Me_3SiC\equiv CSiMe_3$ leads to unprecedented tandem Si–C and C–H activation reactions (*Angew. Chem. Int. Ed.* **2007**, 46, 6907). As Rosenthal describes it, the side reaction proceeds via addition of the hafnocene across one of the Si–C bonds of the acetylene. The intermediate formed rearranges to a linear vinylidene complex bound end-on to hafnium, which stabilizes itself by addition of the hafnium center into a C–H bond of a methyl group of one of the cyclopentadienyl rings. The result is an unusual bridging Hf–C bond. A similar bridging-type bond has been observed by Chirik’s group for hafnocene- N_2 intermediates.

This compound further reacts via a second C–H activation, this time with a trimethylsilyl group, to form a stable five-membered ring—a hafnasilacyclopentene. Calculations by Rosenthal’s longtime collaborators on group 4 chemistry, Eluvathingal D. Jemmis and his group at the Indian Institute of Science, in Bangalore, India, predict the kinetics and thermodynamics of the reactions and support the proposed mechanism.

“This enhanced reactivity of hafnium organometallic compounds should always be considered if syntheses are investigated or applied catalytically,” Rosenthal says. Elaborations on the hafnium chemistry to produce other metallocyclic products are under way in his lab, he says.

Yet another recent report on hafnium chemistry comes from a team at Dow Chemical. The researchers describe an advance in the unique “chain-shuttling polymerization” process they developed for continuous production of tailored olefin block copolymers (*C&EN*, May 8, 2006, page 9). Rather than using a single reactor and two catalysts with substantially different monomer selectivities as in the original process, the team has now demonstrated that it can use just a single hafnium catalyst and two reactors containing different monomers in succession in a continuous process to make diblock copolymers (*Macromolecules* **2007**, 40, 7061).

“This dual-reactor scheme produces a very different material than our single-reactor process,” says Dow’s Phillip D. Hustad, a researcher at the company’s Freeport, Texas, site. Rather than giving a multiblock polymer chain architecture, the polymerization results in chains containing just two blocks.

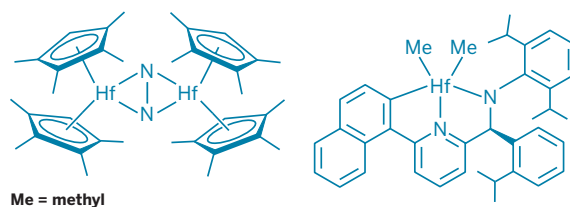
In the original process, the researchers used high-throughput screening to identify potentially useful polyolefin catalysts. They found a zirconium bis(phenoxyimine) catalyst selective for ethylene and a hafnium pyridylamide catalyst highly reactive with 1-octene. The catalysts have bulky ligand systems that restrict access to the metal centers, similar to metallocene catalysts typically used for commercial production of olefin homopolymers and random copolymers.

The chain-shuttling polymerization employs diethylzinc as the chain-transfer reagent. Diethylzinc typically is used to terminate polymer chain growth by transferring the polyolefin chain from the catalyst metal to zinc in exchange for an ethyl group. Usually irreversible, this process has been shown to be reversible in some cases. The Dow researchers take advantage of this reversibility to use the zinc reagent as a reservoir to hold polymer chains as

they are intermittently shuttled between the different catalyst molecules to grow alternating ethylene-octene polymer blocks.

The Dow process has many advantages, the researchers say. For example, it leads to a better quality polymer than random co-

FUNCTIONAL HAFNIUM Chirik’s nitrogen functionalization chemistry takes advantage of hafnium complexes with nitrogen bound side-on (left). Dow Chemical’s olefin polymerization catalyst (right) relies on bulky ligands to help control monomer selectivity.



polymers or two polymers that are physically blended, and it does so in a more efficient, economical, and potentially greener way than current commercial copolymer batch production processes. The polymers have a useful combination of high-melting-point, “hard” crystalline segments with low octene content and low-glass-transition-temperature, “soft” amorphous segments with higher octene content.

To demonstrate the extended technology, the Dow chemists prepared a copolymer with blocks of high-density polyethylene and very-low-density polyethylene. They used the same hafnium pyridylamide catalyst as in the original system. Typically, block copolymers are made one chain at a time by sequentially adding one monomer and then another to a single reactor. In the new process, several polymer chains are produced simultaneously in the first tank reactor, assisted by diethylzinc. The effluent from the first reactor flows into a second reactor, where the second copolymer blocks are added.

Overall, this continuous process ensures a homogeneous copolymer composition within each block “in sharp contrast to materials produced in batch or semibatch processes,” Hustad notes.

On the basis of all these recent studies on hafnium, “a new player has entered the stage of transition-metal chemistry,” Marschner writes. “Hafnium is on track to lose its image as a pale ‘zirconium clone.’” Although the examples witnessed so far are mostly stoichiometric, possible catalytic properties connected to the work are “eagerly anticipated,” he adds. ■



BETHANY HALFORD/C&EN

CLOSE YOUR HOOD!

EASY WAYS to save on energy costs include installing fewer fume hoods and vigilantly closing sashes

BETHANY HALFORD, C&EN WASHINGTON

YOU MIGHT not realize it, but the fume hood whirring away in the corner of your lab is sucking up a lot more than chemical vapors. Fume hoods are serious energy hogs, and their operating costs take a big bite out of budgets.

The average fume hood consumes as much energy as three houses, according to Dale Sartor, an engineer and fume hood expert at Lawrence Berkeley National Laboratory. Operating a fume hood is like opening all the windows in your house and then turning the air-conditioning on full blast, he explains.

All the air the fume hood expels has to be replaced with air from outdoors. "No matter how hot or cold that air is, it has to be heated or air-conditioned, filtered, and then distributed," Sartor says. That's in addition to the energy consumed by the fan that drives the hood.

With energy costs on the rise, cost-conscious chemistry departments are looking for ways to make fume hoods more efficient. One of the simplest ways to do that, Sartor says, is by installing smaller hoods or not putting in fume hoods at all.

"Typically, if you walk around a laboratory building, a lot of the hoods aren't being utilized. They're being used for storage or they're not actively being used. The

problem is that they keep on using energy," Sartor says. Taking unused hoods out of service, sharing hoods, and considering smaller hoods are all measures that can cut down on energy consumption. Of course, it's important to keep in mind that hoods serve a critical safety function, he adds. "Efficiency does not trump safety."

"There's no getting around the problem that the more fume hoods you have, the higher your energy costs will be," says Gary Spessard, a chemistry professor at St. Olaf College in Northfield, Minn.

When the time came to design a new chemistry building at St. Olaf, the original plan included 88 fume hoods. Spessard and his colleagues decided one of the best ways to cut their expenses was to revamp their curriculum so they could cut down on the number of hoods needed.

"Over the past few years, we have developed experiments that follow the tenets of green chemistry, and with green chemistry the necessity for hoods is greatly diminished," Spessard says. Most of the hazards in organic chemistry labs are associated

SAFETY COST
Hoods consume energy as they draw away chemical fumes.

with volatile organic chemicals, he points out. "If you eliminate those, then you don't really need to work in a hood."

St. Olaf was able to reduce the number of hoods in its new building from 88 to 53, saving the school \$250,000 on the cost of the hoods and installation alone. "That's a big savings up front," Spessard notes. But beyond that, the reduction in the number of hoods will save money on heating and cooling costs in years to come.

A green approach also helped at the University of Oregon, where hood space was once so tight for the undergraduate organic chemistry program that instructors had to run labs late at night and on weekends to accommodate all the students.

To solve the problem, the university decided to adopt a greener approach to the traditional organic chemistry laboratory course. Now a class of 44 students uses just six hoods—a big difference from the usual ratio of two students per hood.

The laboratory experiments do not require the entire experiment to be done inside a hood, explains Kathryn Parent, a senior staff associate at the American Chemical Society Green Chemistry Institute who studied the University of Oregon's adoption of a greener curriculum as part of her master's thesis. She estimates that the University of Oregon saved roughly \$250,000 on hoods and installation and nearly \$87,000 annually in energy costs by adopting its greener curriculum.

The hood isn't eliminated entirely, Parent says, but it's used mostly for simple things such as transferring chemicals if they're hazardous or volatile. "Typically, what you're going to see is fewer volatile organic compounds, staying away from halogenated organic compounds like methylene chloride, using air or oxygen rather than a stronger oxidizing agent, doing experiments at ambient temperature or heating with microwave energy, as opposed to refluxing for hours and hours," Parent says.

The drive for fewer fume hoods and greener curricula has been catching the attention of architectural firms. "We're learning more about green chemistry so

The average fume hood consumes as much energy as three houses.

that when we have clients and they're looking to design a new facility, we can give them all the tools and information that we've acquired, and maybe they'll begin to make that switch," says Erika Morgan, an architect for the sustainable design firm Perkins & Will.

"The big thing that surprises people is that it costs less to build an energy-efficient building. People always assume it costs more," adds Gary C. McNay, who designs lab space for colleges and universities for Perkins & Will.

When it comes to designing a more energy-efficient lab, the first thing McNay recommends is reducing the number of hoods. A hood is one piece of the mechanical system, but the number and type of fume hood used impacts a number of systems down the line, he says. "If you could reduce the energy usage by 30% in a laboratory building, that means the mechanical system can be 30% smaller, which means the building costs are less and you're using less energy," McNay adds.

Of course, if you can't cut down on the number of hoods, a number of interesting technologies are still available to improve energy efficiency of those fewer hoods that do get installed. These include low-flow hoods, which restrict sash openings and improve airflow via the hood's aerodynamics, as well as variable-air-volume hoods, which alter their exhaust power on the basis of how far open the sash is.

"Every fume hood manufacturer has some sort of a redesigned product that came into the marketplace within the last three to six years that can operate at a lower flow rate," says Jon Zboralski, director of airflow products at Hamilton Laboratory Workstations, part of Thermo Fisher Scientific.

There are a number of things to consider when picking the best fume hood for your lab: number of hoods, new construction versus retrofit, and climate. But ultimately, Zboralski says, you have to do the math to see if energy savings offset the cost of the equipment.

For established laboratories that are not contemplating refurbishing any time soon, the easiest way to cut the energy costs of fume hoods is simply to make sure that sashes are closed when not in use. "A lot of times, we go into laboratories and people will not be at the hoods, but all the sashes will be open. That's an incredible waste of energy," McNay says.

That point was recently driven home to chemists at Massachusetts Institute of

Technology by a mechanical engineering undergrad, Steven T. Amanti. His senior thesis, "Potential Energy Savings on the MIT Campus," spotlighted how hoods in the chemistry department were frequently left open when not in use. By Amanti's calculations, the department could save \$350,000 annually in utility costs by simply making sure unused hoods were closed.

"I think that the chemistry department was always aware that fume hoods are a large consumer of energy," says Richard J. Wilk, administrative officer for MIT's chemistry department. But, he says, how much energy was lost inadvertently because of hoods being left open came as something of a surprise. "I think with rising energy costs on campus, it really brought the issue to our attention."

THERE'S NOW a campaign at MIT to get researchers to close their hoods when they go home for the night. The positions of fume hood sashes are recorded by the building ventilation control system, and a monthly report of the average sash position is sent to each research group.

"The report makes it easy to spot areas that need improvement," says Jim Doughty, environmental health and safety coordinator for MIT's School of Science. "We're trying to bombard them with this information in as many different venues as we can."

Hood manufacturers are also getting in on the act, introducing measures that restrict a hood's opening or ensure the sash is closed when not in use. Zboralski says one popular trend is to install hoods with combination sashes. These hoods have sashes that can move vertically up and down but also have a panel that slides horizontally. This design, Zboralski explains, gives access to elevated areas inside the hood without having to open the entire sash.

There are also some simple fixes, such as latches or stops that ensure a sash can only rise to a specified height. Other solutions, such as motorized sash closers that kick in when the operator steps away from the hood, are more complex.

"The widgets are there if somebody wants to pay for them," Zboralski says, but ultimately, you have to be sure the energy savings from those widgets are worth it. No matter what all the manufacturers do to their hoods to manage airflow, nothing can make the hood safer than just getting the user to put the glass in front of their face. It's such a simple thing." ■

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Minitab, www.minitab.com

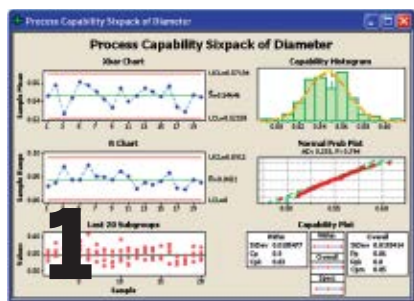
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MOlogic, www.cacheresearch.com/cosmo.html

(2) AlmaKnowledgeServer v2.1 is a literature-mining system that delivers powerful search capabilities and visualization tools. The latest version still allows users to uncover bioentity relationships that exist in more than 8 million PubMed abstracts, but it now includes chemical information and links to external databases. Additional functionality includes query alerts via e-mail, new export options, additional search options, new trend analyses, enhanced graphical information, and new Internet subscription access.

Active Motif, www.active-motif.com/aks

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virtual high-throughput screening of large databases. eHiTS is available for Linux and SGI platforms and is free to academic users. **SimBioSys, www.simbiosys.ca**

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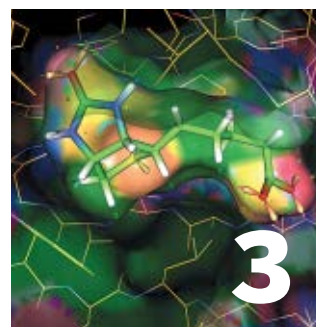
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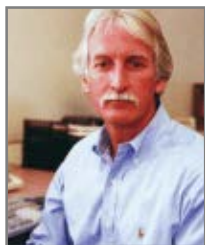
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J. Chem. Theory and Comput.; (Article); **2006**; 2(2); 364-382. DOI: 10.1021/ct0502763

Combining Quantum Mechanics Methods with Molecular Mechanics Methods in ONIOM

Vreven, T.; Byun, K. S.; Komaromi, I.; Dapprich, S.; Montgomery, J. A., Jr.; Morokuma, K.; Frisch, M. J.
J. Chem. Theory and Comput.; (Article); **2006**; 2(3); 815-826. DOI: 10.1021/ct050289g

Quantum Chemical Calculations of the Influence of Anchor-Cum-Spacer Groups on Femtosecond Electron Transfer Times in Dye-Sensitized Semiconductor Nanocrystals

Persson, P.; Lundqvist, M. J.; Ernstorfer, R.; Goddard, W. A., III; Willig, F.
J. Chem. Theory and Comput.; (Article); **2006**; 2(2); 441-451. DOI: 10.1021/ct050141x

Multiscale Coarse-Graining of Mixed Phospholipid/Cholesterol Bilayers

Izvekov, S.; Voth, G. A.
J. Chem. Theory and Comput.; (Article); **2006**; 2(3); 637-648. DOI: 10.1021/ct050300c

Quantifying Aromaticity at the Molecular and Supramolecular Limits: Comparing Homonuclear, Heteronuclear, and H-Bonded Systems

Rehman, A.; Datta, A.; Mallajosyula, S. S.; Pati, S. K.
J. Chem. Theory and Comput.; (Article); **2006**; 2(1); 30-36. DOI: 10.1021/ct0501598



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A Report On The Summit On ACS Committee Structure

JAMES D. BURKE, NEIL D. JESPERSEN, AND E. ANN NALLEY, COCHAIRS, SUMMIT ON ACS COMMITTEE STRUCTURE

AS WAS REPORTED in the June 25 issue of C&EN (page 53), the ACS Board of Directors and the Council Policy Committee (CPC) in 2005 jointly appointed a Governance Review Task Force and charged it with reviewing the society's governance and its constitution and bylaws to ensure that the society's governing framework enables it to best fulfill its mission, meet member needs, and remain a world-class organization.

One recommendation of the Governance Review Task Force subsequently approved by the board and CPC was to hold a Summit on ACS Committee Structure to examine the charges of ACS committees; eliminate undesirable duplication of efforts; and, where committees' interests converge, propose means to link their efforts for more productive outcomes. Fifteen ACS committee leaders plus key staff convened in Baltimore on July 6–8 to focus on innovations that could improve the society's effectiveness. At the fall national meeting in Boston, the ACS Board of Directors, CPC, and the Committee on Committees (ConC) received the committee summit report (available on the Web at www.acs.org/governance).

The summit participants collectively possessed a very broad knowledge of the society's committee structure. They engaged in detailed discussion on the many aspects of how ACS committees function and how the committee structure provides an unrivaled opportunity for member participation in governance. They also identified areas where changes would lead to even greater effectiveness.

The participants assessed the charges and activities of all ACS committees. They agreed on recommendations that are

directed to committee chairs, liaisons between committees, ConC, the board, CPC, and specific committees. They also recommended that ConC and the board address specific instances where the charge or activities should be refocused. In general, committee charges looked appropriate, although in some cases, they were specified in the ACS bylaws. As a consequence,

well-prepared committee chairs are key elements of a successful committee structure, and some specific ideas for improving committee-committee relationships are recommended for inclusion in the training curriculum.

The summit also devoted significant time to considering how the committee structure can best support the strategic priorities of the society. A gap analysis revealed several critical issues that no committee or group of committees currently has sufficiently embraced. Hence, interests such as multidisciplinary, addressing global scientific challenges, graduate education, and online collaboration among chemical scientists were recommended

to specific committees for greater focus and attention. Finally, the summit recommended that the Planning Committee, ConC, the board, and CPC regularly monitor the alignment of the committee structure with the ACS strategic plan and make assignments and adjustments as necessary to respond to key issues.

The summit chairs are in accordance with the June 25 ACS Comment in C&EN, which stated, "Certainly, changes to an organization as successful as ACS are not made lightly." Indeed, the summit participants' appreciation of the society's significant and storied history underlay their suggested improvements to the committee structure that will strengthen their partnership and better position the society as it works toward "Improving people's lives through the transforming power of chemistry."

Views expressed on this page are those of the authors and not necessarily those of ACS.



Burke



Jespersen



Nalley

the ability of the governance structure to be most responsive in a changing environment is unduly limited.

A major focus of the summit was to improve communications and the relationships between committees. The summit developed broad recommendations on the roles of, and best practices for, liaisons between committees. It suggested that when greater interaction is called for than individual liaisons can provide, joint subcommittees and coalitions should be formed. Recommendations were presented for establishing clear, comprehensive goals; more effective liaison reporting; and liaison activity outside meetings. In addition, specific areas in the committee structure where communication seemed insufficient were identified.

The summit also recommended improvements to the already highly regarded training that ConC provides annually for incoming committee chairs. Specifically proposed for inclusion was the notion that



RISING STARS REUNITE

C&EN catches up with **12 WOMEN CHEMISTS** it profiled in 2002

LINDA WANG, C&EN WASHINGTON

A LOT CAN HAPPEN in five years. In 2002, C&EN produced a series of articles on 12 “rising stars” to celebrate the Women Chemists Committee’s (WCC) 75th anniversary. These women chemists were just starting their careers and had futures full of promise.

True to our predictions, they’ve been successful. Many of these women have now received tenure and are full professors. Several have moved to different universities since the original series appeared. A few of them have moved from industry to academia, and one woman found her calling by completely changing her research direction. These women have experienced personal changes as well, with several of them becoming mothers.

Six of the women reunited this past August at the ACS fall national meeting in Boston to present their research in celebration of WCC’s 80th anniversary. C&EN checked in with all 12 women to find out how their lives and their careers have progressed.

For **Valerie Sheares Ashby**, 2002 proved to be a major turning point in her life (C&EN, Aug. 26, 2002, page 34). The Iowa State University assistant professor received tenure, was promoted to

associate professor, and got married—all in the month of August. By January 2003, Ashby was asking herself, “Now what do I do?”

While preparing her tenure package, Ashby realized that she was no longer excited about her research projects in synthetic polymer chemistry. “I had to write at the end of my promotion packet what my future research was going to be,” she says. “In that process of writing about more of the same, I knew I couldn’t do more of the same.”

She had been toying with the idea of moving into biomaterials, but it wasn’t until she completed a brief sabbatical in 2003 studying biological material design in the lab of Robert S. Langer at Massachusetts Institute of Technology that the idea started to gel. “The only way we could really change areas was to let everything that was old go,” she says.

So Ashby took a position as an associate professor at her alma mater, the University

of North Carolina, Chapel Hill. She and her research group, which she brought from Iowa State, took their expertise in synthetic polymer chemistry and began applying it to biological materials. Her timing couldn’t have been better, because the field of biomaterials was beginning to boom and funding was plentiful.

Ashby says she is doing things she never imagined doing five years ago. “We’re having a lab on campus implant some of our



Ashby



Belcher

materials in rats,” she says. “Who would have thought that we would be dealing with rats?”

She says the change has reinvigorated her career, and it has affected her students as well. “When we’re doing things that are more relevant, more up-to-date, they are more excited about their research,” she says.

Ashby was named Gordon & Bowman

UNC

DONNA COVENEY/MIT

REUNION
Havelka, Ashby,
Chan, Cornell,
Belcher, and
Campbell meet
at the ACS
fall national
meeting in
Boston.

the number of minority students pursuing graduate degrees in science, math, and engineering who are interested in becoming professors. In fact, it was through a related program during the summer of 1988 that Ashby, then an undergraduate at UNC, began thinking about pursuing a Ph.D.

Her personal life is also flourishing. Ashby continues to teach Sunday school, just as she did in Iowa, and she attends church every Sunday with her husband, who is a minister. With all the changes in her life, she says, one thing will never change: her faith in God. "That part of my life is constant."

Zhenan Bao believes moving from industry to academia was the right decision for her. In 2002, Bao was a distinguished member of the technical staff at Lucent Technologies' Bell Labs, in Murray Hill, N.J. (C&EN, March 25, 2002, page 28). In March 2004, Bao became an associate

Gray Distinguished Term Professor of Chemistry this past spring. She also directs the National Science Foundation's Alliances for Graduate Education in the Professoriate Program at UNC. The program aims to increase

grads is working on related topics, including organic-based solar cells, carbon-nanotube electronics, and biosensors.

Bao and her husband have two children, ages one and five. She says she has a good work/life balance at Stanford. The university recently started several new programs, including offering a subsidy to faculty members for child care and paying travel expenses for a spouse or nanny to accompany the faculty member to scientific conferences.

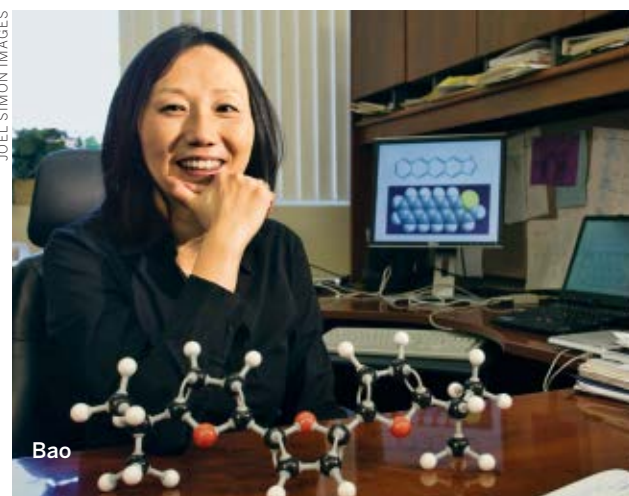
Bao balances her life by setting priorities. Although her work hours are not as regular as they were at Bell Labs, she has managed to work around her schedule and find time for her family. She also makes time for herself. She frequently bikes or walks to work, and during her down time, she calls her parents back home in China.

She says she is enjoying the moment and stops short at predicting where she will be in five years. "Anything can happen in five years," she says.

In 2002, **Angela Belcher** had just moved from the University of Texas, Austin, where she was an assistant professor, to MIT, where she was starting as an associate professor (C&EN, Nov. 25, 2002, page 24).

professor of Materials Science & Engineering & Biological Engineering at MIT. Her research focuses on using biological materials for energy storage and environmentally friendly processing. She is also working on materials for electrochromic devices for

JOEL SIMON IMAGES



Bao

displays, cancer diagnostics, fuel cells, and catalysis.

She says the past five years have been critical in establishing herself as a professor. "I've passed a lot of the major hurdles, and my focus is more on doing interesting research," she says. She became a full professor in 2004 and now manages a lab of 16 graduate students, five postdocs, and several undergrads.

In fact, 2004 was an all-around good year for Belcher. That year, she was also named a MacArthur Fellow. "My life just seemed to really take a turn at that point," she says.

The following year, Belcher had a baby boy. She says she appreciates the supportive environment for women at MIT. "Having people who have gone through that similar experience is really valuable, because some days I just think that I'm going insane," she says. "It's great to have people say, 'You can do it.'"

In addition to her work at MIT, Belcher is cofounder of nanotechnology start-up Cambrios Technologies, in Mountain View, Calif. Belcher is involved in several educational outreach activities involving kids interested in science and engineering.

Asked if she still feels homesick for Texas, the seventh-generation Texan says: "Once you're a Texan, you're always a Texan, and that is always home." Nevertheless, Belcher has created a life for herself in Boston, and her research is thriving. "I

CHRIS MURRAY



Kagan

CURT BRENNAN



Cornell

MERCK



Weber

professor of chemical engineering and a Finmeccanica Faculty Scholar at Stanford University. She says the transition to academia has given her the freedom to pursue a more detailed understanding of certain scientific topics.

Currently, Bao is working on organic thin-film transistors for flexible electronic circuits. Her research group of more than 20 graduate students, postdocs, and under-

At the time, she was feeling homesick for Texas and was in search of a fresh tortilla in Boston. After the C&EN article appeared and exposed her longings, she says, many readers e-mailed her with suggestions for places to try. In the end, Belcher found the best tortilla right under her nose. "My husband has learned to make very good homemade tortillas," she says.

Today, Belcher is Germeshausen Pro-

think the next five years are going to be a complete blast," she says.

A passion for teaching prompted **Cherie R. Kagan** to move from industry to academia. In January 2007, Kagan joined the University of Pennsylvania, her undergraduate alma mater, as a tenured associate professor of electrical and

systems engineering and of materials science and engineering. She left a position as manager of the group on molecular assemblies and devices at IBM's T. J. Watson Research Center, in Yorktown Heights, N.Y. (C&EN, July 29, 2002, page 20).

Kagan and her husband, Christopher B.

Murray, who made a simultaneous move from IBM to Penn, are now getting their labs up and running and are excited about the possibilities ahead. "It's an extremely busy time, and that's to be expected," she says.

Her research will have a broader scope than when she was at IBM. She is studying

PROMOTIONS

For Some Women, Staying Put Has Its Rewards

Carolyn R. Bertozzi (C&EN, Jan. 21, 2002, page 42) was named director of the Molecular Foundry at Lawrence Berkeley National Laboratory in January 2006. The foundry fosters research in nanoscience by providing scientists from academia, industry, national labs, and other research institutes with free access to state-of-the-art instrumentation to pursue experiments that would be difficult to perform in their home institutions. Bertozzi, who is also T. Z. & Irmgard Chu Distinguished Professor in the departments of chemistry and molecular and cell biology at the University of California, Berkeley, is engineering nanoscale materials for interactions with biological systems. Her group is involved in the development



Campbell

DAVID SPIEL/PNNL

of a nanoinjector that employs a carbon nanotube as a needle to inject membrane-impermeable materials into cells. They have also developed biomimetic polymers that passivate the surfaces of carbon nanotubes and reduce their cytotoxicity. The lab continues its development of chemical tools to image glycans in living systems.

Allison Campbell (C&EN, Feb. 25, 2002, page 31) was named director of the William R. Wiley Environmental Molecular Sciences Laboratory, a Department of Energy national sci-

entific user facility at Pacific Northwest National Laboratory, in April 2005. Her research on biomimetic coatings for metal implants is now being commercialized by the company Bacterin International, in Belgrade, Mont. Last year, Campbell received an R&D 100 Award from *R&D Magazine* and a Federal Laboratory Consortium Award for Excellence in Technology Transfer for this research. On a personal note, Campbell now has a third Labrador retriever, and she and her partner, Julie, enjoy hiking and fishing in Canada.

Julia Y. Chan (C&EN, June 24, 2002, page 40) received tenure in 2005 and is now an associate professor of chemistry at Louisiana State University. In the past several years, her research group has grown single crystals of many new intermetallic compounds exhibiting large magnetoresistance and heavy fermion behavior. The work has contributed to the understanding of the relationship between superconductivity and magnetism. Chan also heads the multidisciplinary hiring initiative in materials research at LSU, helping to re-



Chan

cruit a diverse faculty. Chan got married in 2004, and she continues to play violin with the LSU symphony orchestra.

Kathleen O. Havelka (C&EN, Oct. 28, 2002, page 26) has moved from the research side of Lubrizol to the commercial side. She is now global business manager of automotive aftermarket products. She says her technical background has helped her identify emerging areas for innovation that will continue to enable sales growth. In fact, Havelka managed to double sales of automotive aftermarket products in a period of less than three years and to more than double profitability. In addition,



Bertozzi

JEREMY BASKIN

molecular, thin-film organic, and nano-structured materials in devices for electronics, optoelectronics, photonics, and sensors.

Kagan is building an interdisciplinary research group, which currently consists of four graduate students from chemistry, materials science, and electrical engineer-

ing. Kagan also directs the university's nanofabrication facility, which she says is being upgraded with new tooling and infrastructure.

Kagan and her husband now have two children, a daughter age three and a son age one and a half. They have settled into their new home in Pennsylvania and are in

the process of painting it. It's reminiscent of five years ago, when Kagan and her husband were painting their then-new home in New York. "We're doing the same thing all over again," she says.

Ann Weber and **Wendy Cornell** didn't know each other prior to being profiled in C&EN (May 27, 2002, page 28; Sept. 30, 2002, page 19). At the time, Weber was senior director of medicinal chemistry at Merck Research Laboratories, in Rahway, N.J., and Cornell was group leader in the computer-assisted molecular modeling group at Novartis Pharmaceuticals, in Summit, N.J.

The two women met in 2002, when they were both invited to speak at a dinner honoring several of the "rising stars" C&EN profiled. The dinner was hosted by the ACS North Jersey Section's Metro Women Chemists Committee. Weber and Cornell met again at the ACS national meeting in Boston in 2002 and then at the Mid-Atlantic Regional Meeting in Princeton, N.J., in 2003.

In September 2004, Cornell left Novartis to take a position at Merck as director of molecular systems (modeling) in medicinal chemistry. Her group of eight molecular modelers supports more than 20 projects at the company, including a diabetes program that Weber heads. "The exciting thing about working in a modeling group is you tend to be involved in just about all parts of the drug discovery process," Cornell says.

Weber, who is now executive director of medicinal chemistry, has had her share of success as well. In 2002, Weber had been investigating β -3 adrenergic receptor agonists as a possible therapeutic treatment for obesity. She's also experienced disappointments: The program was discontinued after failing to show effectiveness in humans.

Around the same time, however, Weber had started a new diabetes program. The resulting compound, Januvia (sitagliptin), was approved by the Food & Drug Administration in October 2006, and a related product, Janumet (sitagliptin/metformin HCl), was approved in March. She now has another compound that is ready for late-stage clinical development. Although she can't elaborate on the details, she says she will have plenty to report in another five years. ■

Havelka is launching a new line of biofuel products and is writing a handbook titled, "Biofuels: Technical and Commercial Opportunities." Havelka is the immediate past-chair of the ACS Division of Polymer Chemistry. At home, Havelka is getting used to an empty nest. Her daughter, Katie, just started college at Purdue University and is majoring in engineering.

EMPTY NEST Havelka (left), and her daughter, Katie, who just started college at Purdue University and is majoring in engineering.



BILL HAVELKA

Lynda K. Johnson (C&EN, Dec. 23, 2002, page 19) is involved in a completely different research area at DuPont Central R&D, in Wilmington, Del., than she was five years ago. Johnson, now a senior research associate in materials science and engineering, had been developing catalysts for olefin polymerization. When that project was converted into a licensing program, she joined two interdisciplinary research teams that were developing printable electronic materials for applications in flexible electronics and displays. Johnson had to learn everything on the fly and considered it an opportunity to challenge and broaden herself. "In industry, you can't always choose your project, but you can choose what you make of it and what you bring to it," she says, adding that the most rewarding aspect of the past five years has been the opportunity to work with scientists from a diverse range of backgrounds and specialties. Johnson and her husband have two daughters, ages five and eight.

page 37), **Milton Harris '29** Ph.D. Professor of Chemistry and professor of molecular, cellular, and developmental biology at Yale University, says that over the past five years, her lab has broadened considerably.

"Its focus has changed substantially from looking in detail at kinetics and thermodynamics of biomolecular systems outside the cell to evaluating those same chemical features inside the cell," she says. Her group is currently studying how to move miniature proteins—very small, yet well-folded proteins that inhibit or promote protein-protein interactions with exceptional levels of specificity—into the cell to generate molecules that could have potential as intracellular protein drugs. In addition, the lab has begun to study the conformational properties of short β peptides; it was the first lab to report a crystal structure of a bundle of β peptides that have many of the kinetic and thermodynamic features of natural proteins. In work soon to be published, the group reports new chemical tools to char-

acterize different protein conformational states and associations inside the cell.



MIKE GARNER

Johnson



COURTESY OF ALANNA SCHEPARTZ

Schepartz

Alanna Schepartz (C&EN, April 22, 2002,

FIRST ACS PRESIDENTIAL DEBATES

ACS CANDIDATES for president-elect 2008 will participate in the first-ever ACS Presidential Debates this year. On successive Sundays, Oct. 14 and 21, interested members can hear the two candidates, Howard M. Peters and Thomas H. Lane, discuss their visions for the future of the society and their candidacy for the post.

The debates will take place via "Science Studio" a long-running radio show featuring interviews with practicing scientists. Keith Pannell and Russell Chianelli of the department of chemistry at the University of Texas, El Paso, will host the programs. The programs can be heard at 7 PM MST via live stream from radio station KTEP in El Paso at www.ktep.org. Immediately after these dates, recordings of the programs can be accessed at www.sciencestudio.org and www.ktep.org.

BIOL CATCHES SPRING FEVER

STARTING IN 2008, ACS members won't have to wait until the fall national meeting to get their fill of what's new at the interface of chemistry and biology. At the ACS national meeting in New Orleans next April, the ACS Division of Biological Chemistry (BIOL) will host a spring program for the first time in nearly a decade.

BIOL is the society's second-largest division and among its oldest, says John S. Blanchard, an enzymologist at Albert Einstein College of Medicine, Yeshiva University, in New York City, who will serve as the division's president in 2008. Established in 1913, the division has met just once per year for more than a half-century.

The division's decision to expand its programming to both spring and fall meetings reflects the intensity of research activity at the interface of chemistry and biology, notes Tadhg P. Begley, a professor of chemistry and chemical biology at Cornell University and the chair of BIOL's spring program. "Research in biological chemistry is blossoming," he says. "There is far more happening than we can cover in our fall program alone."

The division hopes the move will expand opportunities for young investigators to talk about their research, Blanchard adds. "Our fall programs are dominated by award symposia and invited talks by heavy hitters" in the field, he says. "Expanding to the

spring will give our younger investigators an opportunity to get needed exposure for their work."

BIOL plans to continue—and perhaps even expand—the spring program in the coming years.

In addition to poster sessions, the inaugural program will feature four oral symposia: "Frontiers in Chemical Biology," "New Techniques in Chemical Biology," "Biological Macromolecules," and "Enzymes & Pathways." Each symposium will consist of an invited talk from an established researcher and a number of 20-minute talks from younger researchers, Begley says. The short talks will be chosen from the poster abstracts.

The deadline for submission of abstracts is Oct. 28.

CHEMISTRY OLYMPIAD MENTORS WANTED

HIGH SCHOOL EDUCATORS are invited to apply for mentor positions for the U.S. National Chemistry Olympiad program. Duties during the three-year term from 2009 to 2011 include helping to conduct the national study camp for high school students held at the U.S. Air Force Academy in Colorado during mid-June each year. In their second and third years, mentors generally accompany four U.S. student competitors to the International Chemistry Olympiad (IChO). During the competition, the mentors serve as members of the IChO jury. The 2010 and 2011 IChO events are scheduled to be held in Japan and Turkey, respectively.

Most students at the study camp have completed Advanced Placement Chemistry or the equivalent, therefore instruction at the camp is well beyond the level of high school general chemistry courses. The curriculum also includes considerable laboratory work.

Successful applicants are expected to have background in one or more of the areas of organic, inorganic, analytical, and physical chemistry and biochemistry with classroom experience and should demonstrate involvement with students in special projects or activities. Applicants must be prepared to make a three-year commitment as outlined above. ACS pays all expenses and travel costs, as well as an honorarium.

Interested individuals may obtain an application form at www.acs.org/education by selecting "High School" then "Chemistry Olympiad" or by contacting Margaret Thatcher, Senior Program Associate, U.S.

National Chemistry Olympiad Program, ACS, 1155—16th St., N.W., Washington, D.C. 20036; phone (202) 872-6328.

The deadline for completed applications is Jan. 28, 2008. Applicants must also arrange to have three letters of reference forwarded to Cecilia Hernandez by Feb. 8 at the above address. For more information, please call Hernandez at (202) 872-6169.

4TH PAN-PACIFIC CONFERENCE ON PESTICIDE SCIENCE

THE 4TH PAN-PACIFIC Conference on Pesticide Science sponsored by the ACS Agrochemical Division and the Pesticide Science Society of Japan will be held on June 1–5, 2008, at the Waikiki Beach Marriott Resort & Spa, in Honolulu. Conference chairs are Aldos C. Barefoot and Koichi Yoneyama; program chairs are Joel Coats and Hiroshi Matsumoto.

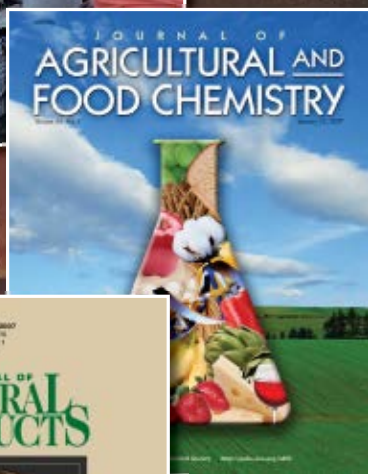
The focus of this conference is identification and resolution of issues related to discovery, selection, evaluation, and use of pesticides intended for crop, public health, and environmental protection. Fostering interactions among pesticide research scientists in the Pan-Pacific region is the primary objective.

Abstract submission opened on Oct. 5 and continues until March 2, 2008. Topics of interest include discovery, invasive species, advances in human vector control, environmental fate and effects, metabolism and toxicology, global trade issues, resistance to pesticides, regulatory and worker protection issues, and analytical chemistry. A workshop on ecological risk assessment (ERA) will feature three lecturers prominent in the field: Keith Solomon, Don MacKay, and Frank Gobas.

Advance registration will be open from Jan. 14 until May 11, 2008. Attendees are encouraged to register in advance to avoid the higher on-site registration fee. Advance/on-site registration fees are as follows: regular registration, \$450/\$500; student registration, \$150. The ERA workshop is an additional \$200.

A block of rooms is reserved at the Waikiki Beach Marriott Resort & Spa. Reservations can be made starting Jan. 14. Rates range from \$179 to \$239 per room per night plus 11.96% tax (subject to change).

Further details on the conference can be found on the conference website: www.panpacificconference.org. ■



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WONG NAMED COTTON MEDALIST

CHI-HUEY WONG, professor of chemistry at Scripps Research Institute, La Jolla, Calif., and president of Academia Sinica in Taipei, Taiwan, is the recipient of the F. A. Cotton Medal, sponsored by the ACS Texas A&M University Section and the Texas A&M department of chemistry. Wong was chosen for his many contributions to new chemical and enzymatic strategies and methods for the synthesis of biologically active compounds.



The Cotton Medal consists of a gold medal and a bronze replica and is named for the late F. Albert Cotton, W. T. Doherty-Welch Foundation Distinguished Professor of Chemistry at Texas A&M. The award, given annually since 1995, recognizes excellence in chemical research.

Wong's research interests are in the areas of bioorganic and synthetic chemistry and biocatalysis, including development of new synthetic chemistry based on enzymatic and chemo-enzymatic reactions; carbohydrate-mediated biological recognition; drug discovery; and carbohydrate microarrays for high-throughput analysis and study of reaction mechanism.

Wong will receive the Cotton Medal at a symposium and dinner at Texas A&M on March 26, 2008.

BARTON TO RECEIVE PAULING AWARD

JACQUELINE K. BARTON, Arthur & Marian Hanisch Memorial Professor of Chemistry at California Institute of Technology, has been selected to receive the 2007 Linus



Pauling Award. The award, sponsored by the ACS Oregon, Puget Sound, and Portland Sections, acknowledges outstanding achievement in chemistry and contributions to the field that have merited national and international recognition. The prize is a gold medal.

Barton pioneered the application of transition-metal complexes to probe recognition and reactions of double-helical DNA. She designed chiral metal complexes that recognize nucleic acid sites with specificities rivaling those of DNA-binding proteins. Most recently, her research group designed bulky metallointercalators as site-specific probes of DNA base mismatches. These complexes are now being applied in the discovery of single base mutations and in new diagnostic and chemotherapeutic strategies targeted to mismatch-repair-deficient cells.

She will receive the award during a symposium on Nov. 17 at Oregon State University, Corvallis.

SEABORG MEDAL WILL GO TO WILLIAMS

R. STANLEY WILLIAMS, HP Senior Fellow at Hewlett-Packard Laboratories and founding director of the HP Quantum Science Research group, will receive the 2007 Glenn T. Seaborg Medal during the 14th Annual Seaborg Symposium on Nov. 3 at the University of California, Los Angeles.

Over the past 30 years, Williams' primary scientific research has been in the areas of solid-state chemistry and physics and their applications to technology. This has led to studies of nanostructures and chemically assembled materials with emphasis on the thermodynamics of size and shape. Most recently, he has examined the fundamental limits of information and computing, which has led to his current research in nanoelectronics and nanophotonics.

The Seaborg Medal was established in 1987 by the UCLA department of chemistry and biochemistry to honor individuals for their significant contributions to chemistry and biochemistry.



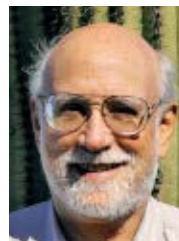
MAGGIORA SELECTED FOR SKOLNIK AWARD; 2009 NOMINATIONS OPEN

GERALD M. MAGGIORA, professor of pharmaceutical sciences at both the University of Arizona, Tucson, and its BIO5 Institute, which brings together scientists from different disciplines to tackle global problems, is the winner of the 2008 Her-

man Skolnik Award presented by the ACS Division of Chemical Information (CINF).

The award recognizes outstanding contributions to and achievements in the theory and practice of chemical information science. The prize consists of a \$3,000 honorarium and a plaque.

Maggiore is considered a leader in the field of chemical information. His contributions include the development of chemical and biological information systems,



applications of neural networks, and applications of computer-assisted decision-making algorithms.

The division has begun accepting nominations for the 2009 Skolnik Award. Nominations should

include the nominee's contributions to the field of chemical information and supporting materials such as a biographical sketch and a list of publications and presentations. Three seconding letters are also required. Send nomination packages to Guenter Grethe, CINF awards chair, at gggrethe@comcast.net. Paper submissions are no longer accepted. The deadline for nominations is June 1, 2008.

GOKEL WINS 2007 MIDWEST AWARD

GEORGE W. GOKEL, Distinguished Professor of Science and associate director of the Center for Nanoscience at the University of Missouri, St. Louis, has been awarded the 2007 Midwest Regional Award by the ACS St. Louis Section.

The annual award recognizes outstanding achievements in chemistry in the Midwest region and is given to a scientist who has made meritorious contributions to the advancement of pure or applied chemistry, chemical education, and the profession of chemistry.



Gokel has developed a new family of anion-selective channels that are amphiphilic peptides. The compounds have been demonstrated to mediate chloride transport in vital lung epithelial tissue. The work may lead to an aerosol drug delivery system

for cystic fibrosis. Gokel is also studying cation- π interactions involving alkali metal cations. He has designed a receptor system that can be systematically varied structurally, sterically, and electronically to probe these cation- π interactions.

Gokel will receive the Midwest Regional Award and deliver an award lecture during the 42nd Midwest Regional Meeting in Kansas City, Mo., that will be held on Nov. 7–9.

ROGERS CHOSEN FOR BAEKELAND AWARD

JOHN A. ROGERS, Founder Professor of Materials Science & Engineering and professor of chemistry at the University of Illinois, Urbana-Champaign, has been selected to receive the 2007 Leo Hendrik Baekeland Award of the ACS North Jersey Section.



The award, presented every two years to an American chemist under the age of 40, recognizes accomplishments in pure or industrial chemistry as characterized by the initiative, creativeness, leadership, and perseverance of the individual and indicated by published or unpublished evidence. The award, which consists of a gold medal and \$5,000, will be presented at a symposium on Nov. 15 at New Jersey Institute of Technology, Newark. Rogers will deliver a talk titled “Bigger Is Better: Nanomaterials for Large-Area Electronics.”

Sponsored by Dow subsidiary Union Carbide, the award was established in 1944 to commemorate the technical and industrial achievements of Leo Hendrik Baekeland and to encourage younger chemists to follow his example.

NOMINEES SOUGHT FOR LEMELSON-MIT PRIZE

THE LEMELSON-MIT Program is accepting nominations for the \$500,000 Lemelson-MIT Prize to recognize outstanding midcareer inventors who have developed a patented product or process of significant value to society that could be or has been adopted for practical use.

The program is also accepting nominations for the \$100,000 Lemelson-MIT Award for Sustainability, which supports

individuals whose inventions enhance economic opportunities and societal well-being while protecting and restoring the natural environment.

Candidates may be individuals or two collaborating inventors, and they must be nominated by one of their peers. Winners will be invited to participate in Lemelson-MIT Program activities, including youth outreach opportunities to inspire young people to pursue creative lives and careers. Nomination guidelines are available at web.mit.edu/invent/. The deadline for nominations is Nov. 2.

19 RECEIVE WCC TRAVEL GRANTS

THE ACS WOMEN Chemists Committee (WCC) has awarded 19 travel grants, sponsored by Eli Lilly & Co., to support undergraduate, graduate, or postdoctoral women chemists who are making their first research presentation at a national scientific meeting.

The winners who presented their research at the ACS national meeting in Boston in August were **April Banaag**, University of Hawaii; **Sarah Bolton**, Syracuse University; **Laura Bourque**, University of



WCC travel grant recipients take time out for a photo in Boston. (Front row, from left) Pharr, Dillman, Banaag, Massoud, Guzman; (back row, from left) WCC Chair Amber Hinkle, ACS President Catherine T. Hunt, Bolton, Stockdill, Widom, Gath, Cope, Bourque, Jacobson, ACS Executive Director and CEO Madeleine Jacobs, and Dawn Brooks, travel grant administrator for Lilly.

California, Irvine; **Kristina Conner**, Dartmouth College; **Elizabeth Cope**, University of Kansas; **Allissa Dillman**, St. Cloud State University; **Sara Encisco**, Harvard University; **Isabella Garcia**, University of Texas-Pan American; **Kerrie Gath**, Texas A&M University; **Dora Guzman**, UC Irvine;

Megan Jacobson, University of Wisconsin, Madison; **Theresa Massoud**, UC Riverside; **Caroline Pharr**, UW Madison; **Jennifer Stockdill**, California Institute of Technology; and **Julia Widom**, Northwestern University.

Anneliese Amacher, UCLA, presented research at the Chemistry of Electronic Materials Gordon Research Conference in July; **Samantha Arnett**, Johns Hopkins University, presented research at the Enzymes, Coenzymes & Metabolic Pathways Gordon Research Conference in July; **Chenpei Hung**, Arizona State University, presented research at the 8th International Hydrogenase Conference in August; and **Emily Rowland**, University of Florida, presented research at the National Organic Chemistry Symposium in June.

For WCC Travel Award information and applications, visit membership.acs.org/W/WCC/.

REMSEN AWARD NOMINATIONS SOUGHT

THE ACS MARYLAND Section is seeking nominations for the Remsen Award, named in honor of Ira Remsen, the first professor of chemistry and second president of Johns Hopkins

University. Remsen Award lecturers are chemists of outstanding achievement, in keeping with Remsen's long and devoted career as a proponent of the highest standards in teaching and research in chemistry. The award consists of a plaque and an honorarium.

The local section is having nominators use the form for ACS national awards available at www.acs.org/funding. (Click on the links for “National Awards,” then “Nominations” to reach the page containing the downloadable form.) The deadline is Nov. 30. Send the completed form and brief

nominee curriculum vitae to Valerie Smith at vsmith@towson.edu.

This section is compiled by LINDA WANG. Announcements of awards may be sent to L_wang@acs.org.

OBITUARIES

Seyhan N. Ege, 76, Arthur F. Thurnau Professor and professor emerita of chemistry at the University of Michigan, died at her home in Ann Arbor, Mich., on Sept. 13.

Born in Ankara, Turkey, Ege spent her early childhood in New York City, where her father represented the Turkish Republic as cultural attaché to the U.S.

Returning to Istanbul at the start of



World War II, Ege attended the American College for Girls, graduating with honors. In 1950, she returned to the U.S., earning an M.S. degree in chemistry from Smith College, in Northampton,

Mass., in 1952 and a Ph.D. in organic chemistry from the University of Michigan in 1956 under the guidance of Peter A. S. Smith.

After teaching briefly at the American College for Girls and Mount Holyoke College, in South Hadley, Mass., Ege returned to the University of Michigan in 1965, where she went on to become the first tenured woman and the first woman full professor on the faculty of its chemistry department. Her research focused on the photochemistry of heterocyclic compounds and reactive intermediates in photochemical reactions. She was named Arthur F. Thurnau Professor in 1990.

Between 1989 and 1991, Ege played a leading role in revamping the department's undergraduate curriculum. A promoter of innovative approaches to teaching chemistry, she authored a textbook, "Organic Chemistry: Structure and Reactivity," which appeared in five editions between 1984 and 2004 and has been translated into Spanish, Italian, and Chinese.

Ege also coauthored the 1994 National Science Foundation report "Innovation and Change in the Chemistry Curriculum," and was the general chair of the 16th Biennial Conference on Chemical Education at the University of Michigan in 2000. She retired from the faculty in 2001.

Ege received many awards, including the Chemical Manufacturers Association's Catalyst Award for excellence in college chemistry teaching and the Sarah Goddard Power Award from the Academic Women's Caucus of the University of Michigan in 2003.

She was one of the founders of the university's Women in Science & Engineering Program, which provides an annual undergraduate award to an outstanding woman or underrepresented minority student.

In her honor, the University of Michigan department of chemistry has established a fund to create the Seyhan N. Ege Junior Faculty Development Award, which will recognize junior faculty members for their teaching accomplishments.

Ege was a longtime member of Ann Arbor's Anthroposophic community, which follows the spiritual science teachings of Rudolf Steiner.

Ege is survived by a sister, Gunes Ege. An emerita member, she joined ACS in 1953.

Paul F. Fabio, an industrial organic chemist, died in Mooresville, N.C., on July 20, the day before his 80th birthday.

Born in Elmhurst, N.Y., Fabio graduated from City College of New York and earned an M.S. degree in chemistry from Stevens Institute of Technology in Hoboken, N.J.

He worked as an organic research chemist with what was then American Cyanamid's Lederle Laboratories division in Pearl River, N.J., for 42 years.

Fabio was a former president of the Tappan Zee Chapter of the American Rhododendron Society, a member of the Knights of Columbus, and a master gardener.

He is survived by his wife of 49 years, Nan; four sons, Gregory, James, Timothy, and Paul John; four grandsons; and three granddaughters. An emeritus member, he joined ACS in 1952.

John W. Gofman, 88, a University of California, Berkeley, professor emeritus and nuclear safety advocate, died of heart failure on Aug. 15 at his home in San Francisco.

Born in Cleveland, Gofman graduated from Oberlin College with an A.B. degree in chemistry in 1939. He earned a doctorate in nuclear and physical chemistry from UC Berkeley in 1943. From 1941 to 1943, he was also co-group leader for plutonium research at UC Berkeley under the Manhattan Project.

He earned a medical degree from UC San Francisco in 1946 before returning to UC Berkeley to join its faculty and conduct coronary heart disease research.

In the early 1960s, he accepted an invitation by the Atomic Energy Commission

(AEC) to help establish the Biomedical Research Division at Lawrence Livermore National Laboratory for the purpose of evaluating the health effects of all types of nuclear activities. He became the division's first director in 1963, while serving as an associate director of the entire laboratory.

After only two years, he stepped down from the administrative activities to have more time for his own research in cancer, chromosomes, and radiation and to analyze data relating to atomic bomb survivors and other epidemiological studies.

On the basis of his findings, Gofman fueled a national inquiry into the safety of atomic power. In 1969, he and Livermore colleague Arthur Tamplin suggested that federal safety guidelines for low-level radiation exposures be drastically reduced, which was contested by AEC. Gofman left Livermore in the 1970s and went on to become an expert witness in radiation-exposure lawsuits; he helped establish a San Francisco-based advocacy group, the Committee for Nuclear Responsibility.

In 1973, Gofman briefly returned to full-time teaching at UC Berkeley before retiring that same year as a professor emeritus of molecular and cell biology to conduct full-time research on the health effects of radiation. This research led to five books. Throughout his career, he also authored more than 100 scientific papers.

Gofman was preceded in death by his wife, Helen, in 2004.

Yury S. Lipatov, 81, a polymer science pioneer, died on Aug. 31 in Kiev, Ukraine.

Born in Ivanovo, Russia, Lipatov graduated from the Moscow Oil Institute in 1949 and completed his Ph.D. in 1954 at Moscow's Physical Chemistry Institute. He was director of the Institute of Macromolecular Chemistry of the National Academy of Sciences of Ukraine, in Kiev, from 1965 until 1985, and head of the institute's physical chemistry of polymers department from 1965 until 2005.

A prominent polymer scientist in the former Soviet Union and a founder of polymer science in Ukraine, Lipatov focused his research on the physical chemistry of polymers, polymer blends, composite materials, liquid-crystalline polymers, and interpenetrating polymer networks.

Lipatov authored or coauthored more than 1,100 scientific papers and 18 monographs on the chemistry, physical chemistry, technology, and physics of polymers

and polymeric materials, including three books.

Lipatov was an associate editor of the *Journal of Adhesion*, *Composite Interfaces*, and *Journal of Polymer Materials*, and he served as an editorial advisory board member of six other polymer journals.

He is survived by his wife, Tatyana, and son, Sergy. Lipatov joined ACS in November 2006.

Gerald J. Murphy, 59, a silicone research chemist, died of cancer on Aug. 22 at his home in Nassau, N.Y.

Born in Haverhill, Mass., Murphy earned a B.S. degree in chemistry from Merrimack College in North Andover, Mass., in 1970 and a Ph.D. in organic chemistry from Massachusetts Institute of Technology in 1974.

After finishing his education, Murphy joined Union Carbide as a research chemist, starting a 33-year career in specialty silicone research management with companies including Witco, Crompton, and General Electric. He ended his career as global manager for product stewardship at Momentive Performance Materials, the independent firm created with the sale of GE Advanced Materials to Apollo Management in December 2006. Murphy is credited with more than two dozen patents.

A resident of Nassau since March, Murphy had lived in Hopewell Junction and LaGrange, N.Y., where he was an active member of the Hudson Valley Iris & Daylily Society. In those communities, he had also been an active member of Saint Columba, Blessed Kateri, and Saint James Roman Catholic parishes, serving as a choir member and cantor. He was also active as a Boy Scout leader and supporter.

Murphy is survived by his wife of 37 years, Ella Mae; three sons, Michael, Matthew, and Timothy; and two grandchildren.

Sister Mary Charles Weschler, 87, a retired chemistry professor, died on Aug. 6 in Erie, Pa.

Weschler entered the Sisters of Mercy at St. Joseph Convent, Titusville, Pa., in 1940, and professed perpetual vows in 1946. She earned a B.S. degree in business education from Mercyhurst College, Erie, in 1940 and an M.S. degree in chemistry

from the University of Notre Dame in 1951. She received her Ph.D. in physical chemistry from Carnegie Institute of Technology in 1955.

Weschler was a faculty member at Mercyhurst from 1946 until 1977, serving as chair of the Division of Natural Science & Mathematics from 1963 to 1977.



From 1959 to 1963, Weschler participated in National Science Foundation-sponsored summer programs at colleges across the U.S. In 1970, she performed

a year of postdoctoral research in environmental science at Argonne National Laboratory.

Beginning in 1976, she was active on the Board of Trustees at Mercyhurst and remained involved in Erie Hospitality House—a shelter for homeless women suffering from domestic abuse—serving as president for several years.

Weschler was named the 1970 Person of the Year by the Erie Engineering Societies Council and a 1997 Women Making History honoree by the Mercy Center for Women. In 1985, the Science Division of Mercyhurst inaugurated the Sister Mary Charles Weschler Lecture Series in her honor.

She is survived by a brother, Vice Adm. Thomas R. Weschler, and many nieces and nephews. An emeritus member, she joined ACS in 1956.

John M. (Mike) White, 68, distinguished professor and the Robert A. Welch Chair in materials chemistry at the University of Texas, Austin, died suddenly from a heart attack on Aug. 31 while visiting his son in Oklahoma City.

Born in Danville, Ill., White received a B.S. degree in chemistry from Harding College in Searcy, Ark., in 1960. He went on to earn a Ph.D. in chemistry from the University of Illinois in 1966, joining the chemistry faculty at UT Austin as an assistant professor the same year. He was named associate professor in 1970 and full professor in 1976.

From 1979 until 1984, he served as chair of the department. He then held the Norman Hackerman Professorship in Chemistry from 1985 until 2000, when he was named the Welch chair.

From 1991 to 2002, he directed the

National Science Foundation-supported Science & Technology Center for the Synthesis, Growth & Analysis of Electronic Materials at UT Austin.

Outside of his work within UT Austin's department of chemistry and biochemistry, White had been a visiting staff member at Los Alamos National Laboratory beginning in 1976. White also served as a program officer at NSF in 1978–79 and was a summer guest worker at the National Bureau of Standards during that same period. In 2004, White began a joint research appointment with Pacific Northwest National Laboratory that led to the establishment of the Department of Energy's Institute for Interfacial Catalysis, which he served as its first director from 2005 until his death.

A pioneer in photochemistry, White focused on photo-assisted surface reactions, materials chemistry, problems in surface chemistry, catalysis, and the dynamics of surface reactions.

He received many honors and awards for his teaching and research, including the Academy of Distinguished Teachers Award



and the Texas Blazers Faculty Excellence Award, both from UT Austin in 2003; the ACS Arthur W. Adanson Award for Distinguished Service in the Advancement of Surface Chemistry in 2001; the ACS South-

west Regional Award in 1999; the ACS Kendall Award in 1990; and UT Austin's Jean Holloway Award for Teaching Excellence in 1998.

He was a member of the American Vacuum Society, the Materials Research Society, and ACS, which he joined 42 years ago.

White published more than 675 papers in professional journals, mentored more than 50 doctoral students, and engaged large numbers of undergraduate students in research. According to colleagues, the success of his students was his top priority.

White is survived by his wife, Gwen; two sons, Mark and Paul; a daughter, RaeAnne Landrum; and two grandchildren. He is also survived by his mother, Frances.

Obituaries are written by SUSAN J.

AINSWORTH. *Obituary notices may be sent to* s_ainsworth@acs.org *and should include a detailed educational and professional history.*

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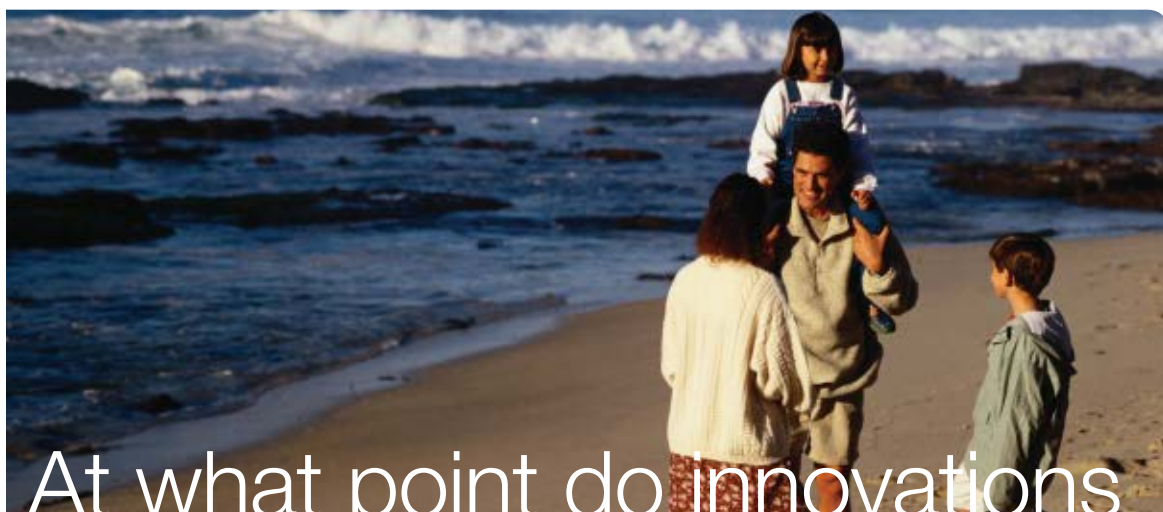
Director, ACS Green Chemistry Institute American Chemical Society

The American Chemical Society, a federally-chartered, non-profit organization, with a multidisciplinary membership of more than 160,000 chemists and chemical engineers, seeks a Director for its Green Chemistry Institute to establish and lead the strategic direction for the Institute, as well as the daily operations of the organization; build its brand and reputation; expand its sources of funding; and lead the development of short- and long-term strategies for the success of the ACS GCI. For more details about GCI, visit its home page at www.greenchemistryinstitute.org. The Director provides the vision necessary to ensure a forward-looking approach to challenges and stimulates new initiatives that will effectively advance Green Chemistry and fulfill the Institute's mission. To enhance the image and implementation of Green Chemistry and Engineering, the incumbent will represent ACS GCI in its relationships with major constituencies and stakeholders, the global scientific and engineering communities, and the public. The Director will coordinate efforts throughout the Society on issues related to Green Chemistry and Green Engineering. The Director will develop funding partnerships that will enable the Institute to leverage the Society's investments. The Director will manage ACS GCI operations and staff, assuring that goals are met in a timely and cost effective manner, and that the Institute serves the stakeholders in an appropriate umbrella role that complements their activities.

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In light of these responsibilities, the successful candidate will be a recognized leader in the Green Chemistry and Green Engineering field who is involved in outreach; a creative thinker; a passionate and effective communicator; an enthusiastic articulator; a strategic leader; comfortable with creating and implementing the big picture; forward-looking, bold, and capable of developing and pursuing an innovative vision to inspire changes in how chemistry is taught; experienced and comfortable working in a visible, high-energy position; and capable of understanding, working with, listening to, and building consensus and collaborating across diverse constituencies. S/he will have an advanced degree or other advanced leadership experience in the area of green chemistry and/or engineering as evidenced by the development of programs, teaching materials, publications, presentations and/or grant materials in green chemistry. The Director will have successful program development skills, as demonstrated by the inception and creation of new governmental, academic or private sector programs related to Green Chemistry or similar environmental programs. An excellent track record of development and fund raising is important. Salary is commensurate with experience. Applicants may submit their résumé by either email, (employment@acs.org); fax: (202-872-4077), or U.S. mail (1155 16th Street, NW Washington, DC 20036 Attn: Human Resources).

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CHEMICAL ENGINEERING, YONSEI UNIVERSITY, KOREA, OPEN-RANK FACULTY POSITION

Department of Chemical Engineering at Yonsei University (<http://chemeng.yonsei.ac.kr>) invites applications for tenure-track faculty position at all ranks with research interests at energy, materials, and process. Preference will be given to individuals with Non-Korean Nationality. Positions are available for Spring 2008. Salary and rank are commensurate with experience. To apply, please submit a CV, three letters of recommendation, research and teaching plans to department chair, **Prof. Tai Gyu Lee** via email: teddy.lee@yonsei.ac.kr. In order to ensure full consideration, applications must be received by October 15th, 2007.

SARAH LAWRENCE COLLEGE seeks a broadly trained chemist for a tenure track position beginning August 1, 2008 to teach general chemistry, other undergraduate courses of interest to liberal arts students, and upper-level courses. Expertise in physical chemistry is desirable. Interest in working closely with students on an individual basis is essential. Ph.D. and teaching experience required. Send CV, copy of graduate transcript, statements of teaching philosophy and research interests, sample descriptions of two courses, and 3 letters of recommendation to: **Chemistry Search, c/o Rosemary Weeks, Sarah Lawrence College, Bronxville, NY 10708**. Application deadline: Nov. 16, 2007. For information on Sarah Lawrence College, our curriculum, teaching methods, and philosophy of education, please see our web site at <http://www.slc.edu>. SLC is an Equal Opportunity Employer committed to achieving a racially and culturally diverse community.

FACULTY POSITION – OPTICAL SPECTROSCOPY

The Department of Chemistry and Biochemistry (<http://chemistry.uark.edu>) at the University of Arkansas is seeking an outstanding scientist for a tenure-track faculty position in the broadly defined field of modern optical spectroscopy, including single-molecule spectroscopy, optical trapping, and/or biospectroscopy. As the position is also associated with the NIHNCRR Center for Protein Structure and Function, there are opportunities for collaboration with the other researchers in the center. In addition, collaborative and multidisciplinary research in computational chemistry, nanomaterials, and bio-analysis are strongly encouraged. The Department and the Center have state-of-the-art core facilities in NMR spectroscopy, protein and small molecule X-ray crystallography, mass spectrometry, and synthesis. The successful candidate must have a Ph.D. and will be expected to establish a nationally recognized research program, and teach effectively at the graduate and undergraduate levels. Review of completed applications will begin on November 15, 2007, and will continue until the position is filled. Curriculum vitae, a five-page statement of research and teaching, and three letters of recommendation should be sent to: **Prof. Xiaogang Peng, Faculty Search Committee, Department of Chemistry and Biochemistry, University of Arkansas, Fayetteville, AR 72701** (xpeng@uark.edu). *Women and minority candidates are strongly encouraged to apply. The University of Arkansas is an Affirmative Action/Equal Opportunity Employer.* All applicants are subject to public disclosure under the Arkansas Freedom of Information Act, and persons hired must have proof of legal authority to work in the United States. This position will be filled based on administrative approval.

ASSISTANT PROFESSOR, BIOORGANIC CHEMISTRY. The Department of Chemistry at Rutgers University in Newark seeks candidates for a tenure-track faculty position beginning September 2008 at the rank of Assistant Professor. The Department solicits applicants with research projects in bioorganic chemistry that emphasize synthesis of molecules of biological interest. Candidates must have a Ph.D. in chemistry or a closely related discipline. The new faculty member will be expected to establish a well-funded research program and have a strong commitment to graduate and undergraduate teaching. The Rutgers campus in Newark is proximal to New Jersey's large pharmaceutical enterprise. Applicants should send a CV, description of research plans, and at least 3 letters of reference to: **Faculty Search Committee, Department of Chemistry, Rutgers, The State University of New Jersey, 73 Warren St., Newark, NJ 07102**, or email application materials (pdf files only) to chemfac@newark.rutgers.edu. Review of applications will begin on November 1, and continue until the position is filled. Also see, <http://chemistry.rutgers.edu>. *Rutgers University is an Equal Opportunity Affirmative Action Employer. Persons from underrepresented groups are strongly encouraged to apply.*

ACADEMIC POSITIONS

UNIVERSITY OF GEORGIA ASSISTANT PROFESSORS INORGANIC & PHYSICAL CHEMISTRY

The University of Georgia invites applications for two tenure-track faculty positions in the Department of Chemistry, for appointments that will commence August 1, 2008. Appointments are expected at the Assistant Professor level, however, consideration will be given to exceptionally well-qualified applicants at the Associate or Full Professor levels. The Department of Chemistry provides an excellent environment for multidisciplinary research. Candidates in all research areas of Inorganic and Physical Chemistry are encouraged to apply. Priority will be given to areas that complement ongoing programs in materials chemistry, nanoscience and environmental chemistry, or to emerging areas of energy research. Successful candidates will have a strong research record, demonstrate creativity in their research plans, and exhibit a strong commitment to teaching. Candidates should submit a curriculum vitae, publication list, concise statement of research plans and teaching philosophy, and arrange to have (at least) three letters of recommendation sent to **Professor John Stickney, Head, Department of Chemistry**. Please Submit All Items Electronically To: InorgPhysSearch@chem.uga.edu. To ensure full consideration, applications must be received by November 1, 2007. *The University of Georgia is an Equal Opportunity/Affirmative Action Institution that encourages applications from women and members of minority groups.*

THE STATE UNIVERSITY OF NEW YORK COLLEGE AT POTSDAM invites applicants for a tenure-track Assistant Professor in chemistry commencing September 1st, 2008. A Ph.D. in chemistry with evidence of excellent teaching, a proven record of potential for scholarly research and a commitment to liberal arts instruction are required. Responsibilities: teaching a one-semester undergraduate inorganic chemistry course, lecture & laboratory, and contributing to other department courses as needed. Successful applicant will establish a research program involving undergraduates in areas such as organometallics, bioinorganic, solid state materials, nanoscience, etc., and to seek external funding. Collaborative & interdisciplinary research is encouraged. For full consideration applications should be received by November 1, 2007. Submit a letter of application CV, copies of graduate transcripts and at least three reference letters to: **Dr. Maria Heipel, Chair, Department of Chemistry, SUNY Potsdam, Potsdam, NY 13676**. *SUNY Potsdam is an AA/EOE committed to excellence through diversity.*

FACULTY POSITIONS

BIOCHEMISTRY AND ANALYTICAL CHEMISTRY

The Chemistry Department at the University of Puget Sound invites applications for two tenure-line faculty positions at the Assistant Professor level to begin Fall Term 2008. Candidates must have a PhD and a strong commitment to undergraduate teaching, liberal arts education, and research with undergraduates. For complete descriptions of the positions, to learn more about the department and our new Science Center please visit our website: <http://www.ups.edu/chemistry.xml>. To apply, submit CV, undergraduate and graduate transcripts, brief statement of teaching philosophy, summary of proposed research, and three letters of reference to: **Biochemistry Or Analytical Chemistry Search, University of Puget Sound, 1500 North Warner #1007, Tacoma, WA 98416-1007**. Located in Tacoma, WA, the University of Puget Sound is a private, predominantly undergraduate institution with approximately 2600 undergraduate students. *EOE/AA*

TENURE-TRACK ASSISTANT PROFESSOR FACULTY POSITION IN ANALYTICAL OR PHYSICAL CHEMISTRY

The Department of Chemistry and Biochemistry at California State University, Chico, is seeking to fill a full-time, academic year, tenure-track Assistant Professor faculty position beginning August 2008. Primary emphasis is in analytical chemistry and instrumentation. Required: Ph.D. in Analytical or Physical Chemistry by no later than the Fall 2008 appointment date; Preferred – Demonstrated potential for excellence in teaching university-level analytical chemistry, post-doctoral experience, and experience with a wide range of instrumentation. Please see the Department of Chemistry and Biochemistry web site for the complete details about the position. <http://www.csuchico.edu/chem>

ACADEMIC POSITIONS

THE UNIVERSITY OF TEXAS AT SAN ANTONIO CHEMICAL EDUCATION FACULTY POSITION

The Department of Chemistry at The University of Texas at San Antonio invites applications for a tenure-track/tenured faculty position in Chemical Education at the Associate/Full Professor level starting Fall 2008 pending budget approval. Successful applicants for this position will be recognized for excellence in teaching, research in chemical education, and effective collaboration with the educational community. Responsibilities include: (1) scholarly activities; (2) development of a chemical education concentration in the M.S. program; (3) teaching and pedagogical coordination in the general chemistry program; (4) outreach activities in the educational community. Required Qualifications: Ph.D. in chemistry or chemical education and academic achievement in chemical education. The Chemistry Department offers the Ph.D., M.S., B.S., B.A. degrees. Screening of applications will begin immediately and continue until the position is filled. Applicants must submit an original signed letter of application stating rank applied for, current dated vitae, description of experience in chemical education, and have three letters of recommendation sent to: **Chair, Search Committee, Department of Chemistry, The University of Texas at San Antonio, One UTSA Circle, San Antonio, Texas 78249-0698**. Applicants who are selected for interviews must be able to show proof that they are eligible and qualified to work in the United States. *The University of Texas at San Antonio is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and individuals with disabilities are encouraged to apply.*

TENURE TRACK POSITIONS

MATERIALS CHEMIST AND BIOCHEMIST

The Department of Chemistry and Biochemistry at Boise State University invites applications from candidates for two tenure-track faculty positions beginning Fall 2008. The Materials Chemist (search #AS-0009-78) should have a PhD in organic or inorganic chemistry and research interests in polymer or materials chemistry. The Biochemist (search #AS-0012-78) should have a PhD and research interests in the field of biomolecular sciences. Both candidates will be expected to develop an externally funded research program, excel in teaching at the chemistry undergraduate and graduate levels, and provide leadership in developing graduate programs. Boise State offers an MS degree in Materials Science and will soon offer degrees in Chemistry (MS), Biomolecular Sciences (PhD), and Materials Science (PhD). For more information see <http://chemistry.boisestate.edu>. Applicants should submit a vita, graduate/undergraduate transcripts, statements of teaching philosophy and research plans, and 3 letters of recommendation to: **Materials Chemist/Biochemist Search Committees, Dept. of Chemistry and Biochemistry, Boise State University, Boise, ID 83725-1520** or email applications to chemistry@boisestate.edu. Review of applications will begin October 15, 2007 and continue until a qualified applicant pool is established. *Boise State University is an EO/AA employer, Veterans preferences.*

THE DEPARTMENT OF CHEMISTRY AT RHODES COLLEGE invites applications for a one-year Visiting Assistant Professor of Chemistry position beginning in August, 2008 with the possibility of extension for another year. The successful candidate should have a Ph.D. and desire to teach at the undergraduate level. Primary duties will be teaching Organic Chemistry and Labs but opportunities exist for interdisciplinary teaching. Send a cover letter and CV, contact information for 3 references, a brief teaching statement, and a transcript to **Dr. Mauricio Cafiero, Chair of the Search Committee, Department of Chemistry, Rhodes College, 2000 North Parkway, Memphis, TN, 38112**; cafierom@rhodes.edu. Completed applications will be reviewed beginning December 1st. Please see our website, <http://www.rhodes.edu>, for further information on this position. *We are an equal opportunity employer committed to diversity in the workforce.*

LONGWOOD UNIVERSITY invites applications for two tenure-track positions (assistant professor level) to begin fall 2008: **Organic and Analytical**. Teaching responsibilities include introductory and upper-division courses/laboratories. A Ph.D. in chemistry is required and teaching experience is desirable. Research with undergraduates is expected. For complete information about the position and the application process, visit <http://www.longwood.edu/chemistry>. *A diversified workforce is part of our strategic plan EOE/AA*

Position Announcement**Postdoctoral Research Associate in Cellulose Nanocomposites**

The Advanced Engineered Wood Composite (AEWC) Center (www.aewc.umaine.edu) and the Forest Bio-products Research Initiative (FBRI) <http://www.forestbio-products.umaine.edu/FBRInews.htm> through a 50:50 joint appointment are seeking a Postdoctoral Research Associate in Cellulose Nanocomposites. The successful candidate will work with a team of researchers in the AEWC and FBRI to develop the next generation of composite materials utilizing nanocellulose.

PURPOSE: Coordinate, manage, and conduct cellulose nanocomposite research to serve the needs of AEWC/FBRI researchers.

ESSENTIAL DUTIES/RESPONSIBILITIES: Conduct scientific research into 1) micro-fibrillated cellulose nano composite polymeric matrix materials including cellulose nanofiber reinforced thermoplastics for ballistic applications, and 2) other nano cellulose materials developed as part of the FBRI while working in an integrated fashion with faculty and staff personnel at the AEWC Center and FBRI. Attract industrial and Federal contract and grant work by actively pursuing RFPs and drafting written proposals to meet needs. Involve AEWC and FBRI personnel/faculty as necessary in proposal writing process related to cellulose nanocomposites, and to obtain funding in support of research activities. Supervise Undergraduate and Graduate Research Associates to ensure validity and accuracy of nano composite manufacturing and testing. Research and recommend purchase for equipment, materials and supplies for use in all cellulose nano composites research projects. Represent AEWC Center and FBRI at national technical meetings. Engage clientele in commercialization of developed nanocomposite technologies. Perform other reasonably related duties as assigned.

KNOWLEDGE AND SKILL QUALIFICATIONS: Ph.D. in Chemistry, Polymer, Wood, Materials Science or related Engineering discipline required. Polymer processing/composite materials experience required. Hands-on experience with cellulose nano fiber production, modification and nanocomposite processing required. Experience with material property testing and analysis required. Demonstrated excellent organizational, written and oral communication skills. Demonstrated judgment while working under pressure to meet constant deadlines. Ability to work independently as well as in a team environment. Applicants must be eligible to accept employment in the United States at the time the appointment is made.

SUPERVISORY RESPONSIBILITIES: Undergraduate Research Assistants, Graduate Research Assistant, and Interns

SALARY: The salary range for this position is \$40,000 - \$50,000 depending upon qualifications.

Review of applications will begin October 15, 2007. Send a cover letter, resume with names, addresses and phone numbers of three references to **Doreen Boutin, 5793 AEWC Bldg., University of Maine, Orono, ME 04469** or to doreen.boutin@umit.maine.edu
The University of Maine is an Equal Opportunity/Affirmative Action Employer and encourages members of under-represented groups to apply.

PROFESSOR AND CHAIR

Georgetown University invites applications and nominations for Professor and Chair of the Department of Chemistry. We are seeking candidates with an internationally recognized research program, strong external funding, demonstrable leadership and administrative ability, excellent interpersonal skills, and a vision for enhancing the research and educational programs of the department. The position is open to all areas of chemistry. Candidates should have a Ph.D. in chemistry or a closely related field.

As part of Georgetown's Master Plan for the Sciences, the new chair will have the unprecedented opportunity to lead the department in a period of rapid development including a new state-of-the-art science building targeted to open in 2010, subsequent renovation of the existing building to the same level, and significant growth in the number of faculty. Additional information about the department can be found at <http://www.georgetown.edu/departments/chemistry>.

Applicants should submit curriculum vitae, the names of three references, and a summary of research and educational activity and plans. Nominations and applications should be sent to the Chemistry Chair Search Committee, Department of Chemistry, Georgetown University, Washington, DC 20057-1227 (email: chemsearch@georgetown.edu). Review of applications will begin Nov. 30, 2007 and will continue until the position is filled.



GEORGETOWN UNIVERSITY

Georgetown University is an Affirmative Action/Equal Opportunity Employer and encourages applications from qualified women and minority candidates.

**TWO CHEMISTRY FACULTY POSITIONS IN
THE ENERGY FOR THE FUTURE
INITIATIVE AT THE UNIVERSITY OF CALIFORNIA,
DAVIS**

The UC Davis Department of Chemistry (<http://www.chem.ucdavis.edu/>) invites applications for two Chemistry faculty positions associated with the UC Davis Energy for the Future Initiative targeting major energy issues facing California and the nation. **One position** is at the Assistant Professor level, and the **other position** could be at a tenured rank (Associate or Full Professor). Online applications for these positions are available at <http://energy.ucdavis.edu>. This website also provides further information about the Energy for the Future Initiative, which brings a total of fourteen new faculty positions to the campus, including a total of four positions in the Chemistry Department to be filled over a 2-3 year period. The search is open to all areas of fundamental chemistry targeting energy science and technology. However, two areas are of special interest: (i) New Materials for Energy Applications, and (ii) Bio-Inspired, Biochemical, and Biological Approaches to Energy Generation and Utilization. Competitive candidates will bring a strong research program in chemistry relevant to energy, as well as a strong commitment to undergraduate and graduate teaching. A Ph.D. or equivalent degree in Chemistry or related disciplines is required. The positions are open until filled; but to assure full consideration, online applications should be submitted no later than October 15, 2007, for a targeted start date of July 1, 2008. *The University of California is an affirmative action/equal opportunity employer.*

When responding to a position
please mention you saw the ad in

**CHEMICAL &
ENGINEERING NEWS**

DEAN OF SCIENCE

FLSA Status: Exempt

Compensation: Commensurate with qualifications and experience

College Web Site: www.cuny.edu

Notice Number: EA13916

Closing Date: 11/19/07 - An appointment effective January 1 or August 1, 2008 is anticipated.

POSITION DESCRIPTION AND DUTIES

The City College of New York invites applications and nominations for the position of Dean of the Division of Science. City College is the oldest senior college in the City University of New York system, and has been committed to the dual goals of accessibility and academic quality since its founding in 1847. It has an international reputation for its ability to promote scholarly excellence in students of diverse ethnic and cultural backgrounds and economic circumstances. The Division of Science, a unit of the College of Liberal Arts and Sciences at City College, comprises five academic departments (Biology, Chemistry, Earth and Atmospheric Sciences, Mathematics and Physics). The Division is a major center for research and scholarship, generating over \$18,000,000 in research funding per year. The Division boasts nine Nobel laureates among its alumni.

The Dean will assume leadership in the management and administration of the Division, curriculum development, program planning, budgeting, and the acquisition of external funding. He or she will lead the expansion of the division which will include a comprehensive new science facility for the CCNY campus.

QUALIFICATION REQUIREMENTS

Candidates should possess distinguished records of scholarship and teaching, significant academic administrative experience, and strong leadership qualities and communication skills. Candidates should currently hold a tenured faculty position or equivalent, and have administrative experience at least at the level of Department Chair or equivalent. They should qualify for appointment at the rank of full professor in one of the departments of the Division, through demonstrated excellence in teaching, scholarship, and service. They should be responsive to the needs of faculty and the diverse student body, and committed to cultural and intellectual diversity. Candidates should be able to serve as effective and forceful advocates of the role of the Sciences and have a demonstrated commitment to public education.

TO APPLY

Applicants should send a letter of interest, their curriculum vitae, and the names, telephone numbers, mailing and e-mail addresses of at least four (4) professional references postmarked by the closing date to: **Search Committee for the Dean of the Division of Science, Administration Building, Rm 218, The City College of New York, 160 Convent Avenue, New York, NY 10031.**

The City University of New York is an Equal Employment Opportunity/Affirmative Action/Immigration Reform and Control Act/Americans with Disabilities Act Employer

CITY COLLEGE IS CUNY

ACADEMIC POSITIONS

RESEARCH SCIENTIST (SYNTHETIC ORGANIC CHEMISTRY) (JOB 01-1218)

Southwest Research Institute®, Chemistry and Chemical Engineering Division, is looking for a Research Scientist (Synthetic Organic Chemistry) in its San Antonio, TX offices. Will market, manage and execute projects in synthetic organic chemistry; develop new technology platforms, expand upon existing platforms; and conduct independent research in the area of synthetic organic chemistry; manage research and technical level associates, write proposals for contract research and government grants; and provide expert knowledge in the area of synthesis, purification and characterization of organic compounds for various synthetic applications. Requires a strong background and proven track record in the multi-step, total synthesis of complex natural products, or small molecule organic compounds. Previous experience in large-scale synthesis or process chemistry is highly preferred. cGMP experience a plus. Requires a PhD in Synthetic Organic Chemistry or equivalent or an MS in Organic Chemistry, with 2 years previous industry-related experience. Must have excellent oral and written communication skills for writing reports, presentations, and personal interaction with staff members and customers. Experience in the design and execution of multi-step synthesis of complex organic compounds and strong working knowledge of modern synthetic reactions and laboratory techniques (1 gm to multi-kilogram scale) are required. A valid/clear driver's license is required. Special Considerations: Applicants selected will be subject to a government security investigation and must meet eligibility requirements for access to classified information. Applicant must be a U.S. citizen. For more information, email Stan.McHardy@swri.org or visit us on the web at www.swri.jobs to review job openings and complete an on-line application. *An Equal Opportunity Affirmative Action Employer MF/D/V Committed to Diversity in the Workplace*

DEPARTMENT OF CHEMISTRY AND PHYSICS AT SOUTHWESTERN OKLAHOMA STATE UNIVERSITY invites applications for the position of Assistant Professor of Chemistry, Tenure Track, Department of Chemistry and Physics, Position 08-F010, beginning August 2008. Teaching duties include the area of specialization, general chemistry, and possibly general education science courses. The successful candidate will be expected to direct undergraduate research projects and/or become involved in other areas of scholarly activity. Undergraduate advising and departmental, university, and community service are also expected. Ph.D. in Organic Chemistry required, however ABD will be considered. Strong commitment to teaching and research at the undergraduate level required. Relevant teaching experience preferred. Submit cover letter referencing Position 08-F010, curriculum vitae, unofficial transcripts, statement of teaching philosophy and research plans, and three letters of recommendation to **Human Resources, Southwestern Oklahoma State University, 100 Campus Drive, Weatherford, OK 73096** or e-mail application materials to jobs@swosu.edu. Review of applications will begin November 1, 2007 and continue until the position is filled. For additional information visit www.swosu.edu. AA/EEO.

TENURE TRACK FACULTY POSITIONS

The Chemistry Department at East Tennessee State University (please visit www.etsu.edu/chemists/) invites applications for tenure-track positions in **Analytical Chemistry, Organic Chemistry, and Chemical Education**, each at the Assistant Professor level to begin August, 2008. Our department offers ACS-Approved degrees in Chemistry and Biochemistry and an MS degree. Candidates must have finished the requirements for the Ph.D. in their fields by hire date, and post-doctoral experience is desirable. A commitment to excellence and innovation in teaching and a high potential for seeking external funding for research in cutting edge fields are expected. The position in Chemical Education includes an opportunity for involvement in our University's newly established Center of Excellence in Mathematics and Science Education, which develops outreach and support for K-12. Review of applications will begin October 1 for the Chemical Education position and November 15, 2007 for the others. Applicants should send vita, official transcripts, three letters of recommendation and statements of teaching and research goals to: **Chair, Chemistry Department, Box 70695, East Tennessee State University, Johnson City, Tennessee 37614-1710**, or electronically: r21jeff@etsu.edu. Position contingent on funding. AA/EEO

ACADEMIC POSITIONS

UNIVERSITY AT ALBANY ASSISTANT PROFESSOR (TENURE-TRACK) BIOORGANIC CHEMISTRY

The Department of Chemistry at the University at Albany, State University of New York, invites applications from outstanding individuals who can develop externally funded, nationally recognized programs in the area of organic synthesis relevant to nucleic acid chemistry. The successful candidate is also expected to teach courses in organic chemistry. Candidates must have a Ph.D. degree from a university accredited by a U.S. Department of Education or an internationally recognized accrediting organization. Applications sent in PDF are preferable. Applicants should submit a CV, representative publications (PDFs), statements of teaching and research interests, and have three letters of reference sent, by e-mail, to chemdept@albany.edu. All applicants must address in their applications their abilities to work with, and instruct, a culturally diverse population. The successful candidate will be offered a competitive start-up package and salary. Review of applications will begin on November 15, 2007 and continue until the position is filled. *The University at Albany is an EO/AA/IRCA/ADA employer.*

INORGANIC FACULTY POSITION UNIVERSITY OF CALIFORNIA, LOS ANGELES (UCLA)

The Department of Chemistry and Biochemistry of the University of California, Los Angeles, invites applications for a faculty position in Inorganic Chemistry at the Assistant, Associate, or Full Professor rank. We are seeking a candidate who will establish a vigorous and innovative research program. Depending on the level, candidates must give evidence of potential or demonstrated distinction in scholarship and teaching. Applications should include a curriculum vitae, a statement of research accomplishments and proposed research plans (not exceeding four pages), and reprints of representative publications. Applicants at the Assistant Professor level should also arrange for three letters of recommendation to be mailed to the address below. To assure consideration, all application materials and letters should be received by November 2, 2007 and directed to: **Chair, Inorganic Search Committee, Department of Chemistry and Biochemistry, University of California, Los Angeles, P.O. Box 951569, Los Angeles, CA 90095-1569; Fax: (310) 206-8010. UCLA is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.**

RICE UNIVERSITY. The Department of Chemistry at Rice University anticipates the availability of a tenure-track position in chemistry. The highest priority will be placed on candidates who demonstrate a strong ability to establish cutting-edge research programs in their chosen fields. The department's strongest needs currently are in physical and inorganic chemistry. The candidate should indicate in the cover letter in which subject areas he/she would be willing to teach. A doctoral degree in chemistry or a related science is required and postdoctoral experience is desirable. Outstanding candidates who have a strong commitment to both research and teaching are encouraged to apply. In exceptional cases, it may be possible to consider candidates at advanced ranks. All letters of application should include a curriculum vita, a publications list and a description of proposed research projects. These should be sent to: **Chair, Chemistry Faculty Search Committee, Department of Chemistry MS 60, Rice University, 6100 Main Street, Houston, Texas 77005-1892.** Please reference Job Code: CEN when applying. The applicant should also arrange for three letters of recommendation to be sent to the above address. The review of applications will begin on November 1, 2007, and all application materials should be received prior to that date to guarantee full consideration. *Rice University is an Equal Opportunity/Affirmative Action Employer; women and minority candidates are strongly encouraged to apply.*

WESTERN STATE COLLEGE OF COLORADO

Tenure track Organic position starting August 2008. PhD required. Candidates must possess commitment to undergraduate education and demonstrate excellence in teaching. Teaching responsibilities include organic and introductory courses with opportunities in biochemistry and/or scientific writing. Supervision of undergraduate research is essential. Western is a residential, four-year public undergraduate college with an enrollment of 2400 students from all fifty states. Review of applications will begin November 26, 2007 and continue until the position is filled. Visit <http://www.western.edu/hr/jobs> for full position announcement and application requirements. AA/EEO

ACADEMIC POSITIONS

LEHIGH UNIVERSITY ASSISTANT PROFESSOR OF CHEMICAL ENGINEERING

The Department of Chemical Engineering at Lehigh University seeks applications for a faculty position of Assistant Professor with a preferred starting date of August 2008. We are looking for candidates with research interests in Interfacial Science and Engineering, particularly in one or more areas related to complex fluids, soft matter, interfacial phenomena, molecular theory and simulations, and micro/nano scale systems. The campus has strong interdisciplinary and interdepartmental groups in biotechnology, materials, polymers, interfaces, and nanotechnology with which the candidate can interact. The successful candidate will be expected to develop a nationally recognized research program and to engage in enthusiastic teaching of undergraduate and graduate students in chemical engineering. Candidates should send electronically a curriculum vitae, graduate transcript, detailed statement of research and teaching plans, and the names and addresses of four references to: **chesearch@lehigh.edu** and address it to: **Chair, Interfacial Science and Engineering Search Committee.** Review of applications will begin immediately, but applications will be considered until the position is filled. Information on the Department and Lehigh University can be found at <http://www.che.lehigh.edu>. *Lehigh University is committed to recruiting, retaining and tenuring women and members of minority groups.*

LEHIGH UNIVERSITY CHEMICAL ENGINEERING POSITION IN THE ENERGY SCIENCES

The Department of Chemical Engineering at Lehigh University seeks nominations and applications for a faculty position in the broad field of Energy Sciences, this includes, but is not restricted to the general areas of Energy Systems, Chemical Processing, Optimization, Reaction Engineering, Separation Science, Biocatalysis, Biofuels and Environmental. The successful candidate will be expected to develop a strong research program and to engage in enthusiastic teaching of undergraduate and graduate students in chemical engineering. The campus has a strong tradition of interdisciplinary work and joint appointments with other departments are possible. Rank of the position will be commensurate with experience and, for exceptionally well established candidates, an endowed chair position will be considered. Candidates should send electronically their curriculum vitae, a detailed statement of research and teaching plans, and the names and addresses of four (4) references to energysrch@lehigh.edu and address it to: **Chair, Energy Search Committee.** Junior faculty applicants must also include a copy of their graduate transcript. Review of applications will begin immediately, but applications will be considered until the position is filled. Information on the Department and Lehigh University can be found at <http://www.che.lehigh.edu>. *Lehigh University is committed to recruiting, retaining and tenuring women and members of minority groups.*

ADAMS STATE COLLEGE IN COLORADO invites applications for two tenure-track Assistant Professor positions in Chemistry. Ph.D. in Chemistry or Chemical Education and significant experience in analytical chemistry, physical chemistry, and/or inorganic chemistry required. Complete job description at <http://www2.adams.edu/administration/hr/smt/smt.php>. Send cover letter, teaching philosophy and professional interests, resume, complete transcripts, and three current reference letters to **Dr. Matthew Nehring, Department of Chemistry, Computer Science, and Mathematics, Adams State College, Alamosa, CO 81102 (msnehrin@adams.edu)** by Nov. 16, 2007. AA/EEO.

FORENSIC AND ORGANIC/ ORGANOMETALLIC CHEMISTRY

The University of North Texas invites applications for tenure-track junior Organic/Organometallic/Catalytic and senior (Assoc. or Full) Forensic/Toxicology Chemistry faculty positions. A PhD in chemistry is required, and post-doctoral experience is preferred. Candidates are expected to establish funded, nationally-recognized, experimental research programs. See www.chem.unt.edu for details. Send CV, research plans, and three reference letters to **Search Committee Chair, Chemistry Department, University of North Texas, PO Box 305070, Denton, TX 76203.** Screening begins immediately and will continue until the positions are filled. AA/ADA/EOE

ACADEMIC POSITIONS

TENURE TRACK POSITION IN BIOCHEMISTRY

The Department of Chemistry and Food Science at Framingham State College seeks to fill a tenure track position at the Assistant Professor level in Biochemistry effective September 1, 2008. The department currently has eight full time faculty members and is ACS approved, with an IFT-modeled food science curriculum. State of the art facilities are available for teaching and research activities. The candidate must have a Ph.D. in Biochemistry or a related discipline, a desire to participate in the undergraduate research program and a strong commitment to teaching excellence. Teaching assignments will include a biochemistry course with laboratory as well as introductory level chemistry lecture and laboratory courses. Applicants should have expertise in bioanalytical chemistry, molecular modeling, informational biomolecules and biotechnology lab methods. Preference will be given to candidates whose teaching and research skills complement the current staff. Interested individuals should send a CV, a brief research plan, a statement of teaching philosophy, Official undergraduate and graduate transcripts, and three letters of recommendation to: **Dr. Louise A. Bodack, Chair, Faculty Search Committee, Chemistry & Food Science Department, Framingham State College, 100 State Street, Hemenway Hall, Framingham, MA 01701.** Review of completed applications will continue until the position is filled, with priority given to applications received by November 15, 2007. Please reference posting # 07-34. No electronic applications will be considered. *Framingham State College is an Affirmative Action/Equal Opportunity Employer.*

BIOANALYTICAL CHEMISTRY

The Albion College Chemistry Department invites applications for a tenure track position beginning August 2008. Applicants should have a Ph.D. in Chemistry or Biochemistry and a commitment to excellence in teaching in a liberal arts environment. The successful candidate is expected to develop an active student-faculty collaborative research program. We are especially interested in candidates that can contribute to both Analytical and Biochemistry curricula. For more information about our new science building and our unique scholarly environment, please visit our website at www.albion.edu/chemistry. Applications, including a CV, a statement of teaching philosophy, research plans, copies of undergraduate and graduate transcripts, and three letters of reference should be sent to: **Craig Bieler, Chair, Chemistry Department, Albion College, Albion, MI, 49224.** *Albion College is a selective, private liberal arts college of 1800 students located in a culturally diverse community in south-central Michigan, and is an equal opportunity employer committed to diversity as a core institutional value.* Review of applications will begin October 22, 2007 and continue until the position is filled.

GRAND VALLEY STATE UNIVERSITY CHEMISTRY DEPARTMENT invites applications for two tenure-track assistant professor positions in **Organic Chemistry** and **Biochemistry** to begin August 2008. The positions require a Ph.D. and a strong commitment to and demonstrated excellence in undergraduate teaching and research. The Chemistry Department values candidates who demonstrate an ability to work in a collaborative environment with a diverse population of colleagues and students, and also have experience with a variety of teaching methods. Responsibilities include teaching at all levels in the area of expertise and directing undergraduate research. Application review will begin October 15 and continue until the positions are filled. Candidates must apply on-line at www.gvsujobs.org and also arrange for three letters of recommendation to be sent separately to **Search Committee, Chemistry Department, 327 Padnos Hall, Grand Valley State University, Allendale, MI 49401.** *GVSU is an affirmative action, equal opportunity institution.*

APPLICATIONS ARE INVITED for future openings as they may occur for the positions of **Postdoctoral Research Associate** and **Research Scientist** in the Department of Chemistry at the University of Nevada, Reno. These positions are non-tenure track and will be filled as funds become available. A Ph.D. in Chemistry, Chemical Physics, or a closely related field is required. Rank depends on qualifications and experience. For the complete position announcement, on-line application instructions, and information on the department and currently available positions see <http://www.chem.unr.edu/postdocsearch>. Applications are accepted on an ongoing basis and retained for twelve months. *EOE/AA. Women and under-represented groups are encouraged to apply.*

ACADEMIC POSITIONS

Faculty Position in Chemical Biology.

The Life Sciences Institute (LSI) at the University of Michigan invites applications for a position at the rank of Assistant or Associate Professor in the field of chemical biology. Chemical biology is broadly defined and the successful applicant will use chemical methods to address an important biological question.

The LSI is a scientific enterprise at the University of Michigan dedicated to opening new scientific paths by blending diverse research talents in a state-of-the-art collaborative physical space (www.lsi.umich.edu). The LSI is currently home to 26 interactive faculty in the areas of cell biology, genetics, bioinformatics, structural biology, signaling, and chemistry.

Candidates are expected to develop an internationally recognized program of scholarly research and to excel in teaching at undergraduate and graduate levels. The positions will remain open until filled but preference will be given to applicants who have submitted all requested materials prior to October 15, 2007. Applicants should send the following (in PDF format): a curriculum vitae, copies of up to three reprints, a one- to two-page summary of research plans, and arrange to have three letters of reference sent directly to: **Isichembio@umich.edu.** Women and minorities are encouraged to apply.

The University of Michigan is supportive of the needs of dual career couples and is a non-discriminatory, affirmative action employer.



TENURE TRACK POSITION, HENDRIX COLLEGE

Applications are being accepted for a faculty appointment beginning August 2008 in the Department of Chemistry. Candidates must be committed to excellence in teaching and to the establishment of a sustainable research program with undergraduates. Ph.D. required, postdoctoral experience preferred. Competitive start-up funding and research time assignment provided in new facilities. The successful candidate will teach either inorganic or analytical chemistry while participating in general chemistry and non-majors chemistry courses. While the appointment will likely be at the level of assistant professor, applications for other ranks will be considered. Details regarding this position are available at www.hendrix.edu/chemsearch. Hendrix College is a selective liberal arts college which is strong in the sciences, and has a firm commitment to green chemistry. Send letter, CV, undergraduate and graduate transcripts, teaching philosophy, and detailed research plans, and arrange for three letters of reference (including the phone numbers and email addresses of the references) to be sent to **Dr. Tom Goodwin, Department of Chemistry, Hendrix College, 1600 Washington Avenue, Conway, AR 72032.** Review of the applications will begin on October 19, 2007, and will continue until the position is filled. *Hendrix is an equal opportunity employer.* Hendrix is a distinguished liberal arts college with an endowment of \$200 million, sheltering a chapter of Phi Beta Kappa, located in Conway, Arkansas, thirty miles from Little Rock at the foothills of the Ozark Mountains. The College, related to the United Methodist Church, has a strong commitment to excellence in teaching liberal arts. *Hendrix is an equal opportunity employer. Women and members of minority groups are especially encouraged to apply.* Please visit our website at www.hendrix.edu.

HUMBOLDT STATE UNIVERSITY

Atmospheric/Physical Chemistry. Tenure-track position beginning August 2008. Ph.D. in Atmospheric or Physical Chemistry or closely-related field. **Department of Chemistry, Humboldt State University, Arcata, CA 95521-8299.** Job #7402. See <http://www.humboldt.edu/~aps/employment/tenure.html> to apply. *EO/AA/Title IX/ADA employer. Women and minorities are encouraged to apply.* Application receipt no later than 2 November 2007.

ACADEMIC POSITIONS



Massachusetts Institute of Technology

It takes everyone at MIT to be MIT.

Assistant Professor

The MIT Department of Chemical Engineering (<http://web.mit.edu/cheme/>) invites applications for a tenure-track faculty position at the assistant professor level, to begin July 2008 or thereafter. Applicants should hold a Ph.D. in chemical engineering or a related field by the beginning of the appointment period. In special cases, a more senior faculty appointment might be possible. The candidate should have demonstrated excellence in original research and a strong commitment to teaching, both at the graduate and undergraduate levels.

Interested candidates should send application materials to chefacs@mit.edu. Each application should include: a curriculum vitae; the names and addresses of three or more references; a strategic statement of research interests; and a statement of teaching interests. We request that each candidate arrange for reference letters to be sent directly to chefacs@mit.edu, with a copy mailed to: Chair, Faculty Search Committee, Department of Chemical Engineering, Massachusetts Institute of Technology, Bldg 66 - Room 350, 77 Massachusetts Avenue, Cambridge, MA 02139-4307. Responses by 1 November 2007 will be given priority.

We especially encourage minorities and women to apply because of MIT's strong commitment to diversity in engineering education, research and practice. MIT is an Equal Opportunity/Affirmative Action employer.

<http://web.mit.edu>

LINCOLN LABORATORY MASSACHUSETTS INSTITUTE OF TECHNOLOGY

MIT Lincoln Laboratory is a premier employer applying science and advanced technology to critical, real-world problems of national interest.

Synthetic Chemist

Will be responsible for the independent design of methods for the synthesis and characterization of novel organic materials used in a variety of applications such as lithography or chemical sensing. Will initiate and carry out tasks requiring synthesis, formulation, and characterization of nanoparticles, small molecules, and polymers. Will coordinate activities with other members of a multi-disciplinary team. Will take part in program development and in initiating new research directions.

PhD in Organic Chemistry, Polymer Chemistry, or equivalent. Laboratory experience with organic synthesis or polymer chemistry is required. Experience operating and maintain instrumentation employed in chemical synthesis and characterization is highly desired. Experience writing technical proposals and reports is desired. Organic synthesis or synthesis of oligomeric/polymeric materials is required. Operation and maintenance of instrumentation is highly desired. Candidate must have excellent organizational, analytical, and problem solving skills and the ability to cooperate with peers in a team environment. Must be a highly motivated self-starter. The ability to communicate and interface with scientists from other disciplines is highly desired.

Please apply online at:
<http://www.ll.mit.edu/careers/careers.html>
Lincoln Laboratory is an Equal Opportunity Employer.
M/F/D/V - U.S. Citizenship required.

ACADEMIC POSITIONS

THE DEPARTMENT OF CHEMISTRY AND PHYSICS AT SOUTHEASTERN LOUISIANA UNIVERSITY invites applications for a tenure-track position in Inorganic Chemistry or a closely related field beginning August 2008. Southeastern Louisiana University, a progressive regional, comprehensive, interactive university, enrolls over 15,000 undergraduate and graduate students. The University's home, Hammond, is at the cross roads of Interstates 55 and 12 in the heart of Louisiana's thriving Northshore, the fastest growing region of the state. Applicants must have a Ph.D. in chemistry or a closely related discipline and a strong commitment to undergraduate teaching at all levels. The successful candidate will be expected to develop a research program involving undergraduate students and/or students enrolled in the Masters of Integrated Science and Technology. We are seeking a candidate whose research interests complement the existing research programs in the department. Undergraduate teaching experience and a proven record of supervising undergraduate research successfully are preferred. Applicants must be committed to working with diversity. To ensure consideration, application materials must be received by December 3, 2007. Qualified applicants should send a letter of application, a current curriculum vitae, copies of all undergraduate and graduate transcripts (official transcripts will be required of finalists), names and contact information of three references, a statement of teaching experience and philosophy, and a statement of research plans. Application materials should be sent to: **Chair, Inorganic Chemistry Search Committee, Department of Chemistry and Physics, Southeastern Louisiana University, SLU Box 10878, Hammond, LA 70402.** Information about the Department of Chemistry and Physics can be found at www.chem.selu.edu. Southeastern is an AA/ADA/EEO employer.

THE DEPARTMENT OF CHEMISTRY AND PHYSICS AT SOUTHEASTERN LOUISIANA UNIVERSITY invites applications for two tenure-track positions in Organic Chemistry or a closely related field beginning August 2008. Southeastern Louisiana University, a progressive regional, comprehensive, interactive university, enrolls over 15,000 undergraduate and graduate students. The University's home, Hammond, is at the cross roads of Interstates 55 and 12 in the heart of Louisiana's thriving Northshore, the fastest growing region of the state. Applicants must have a Ph.D. in chemistry or a closely related discipline and a strong commitment to undergraduate teaching at all levels. The successful candidate will be expected to develop a research program involving undergraduate students and/or students enrolled in the Masters of Integrated Science and Technology. We are seeking a candidate whose research interests complement the existing research programs in the department. Undergraduate teaching experience and a proven record of supervising undergraduate research successfully are preferred. Applicants must be committed to working with diversity. To ensure consideration, application materials must be received by December 3, 2007. Qualified applicants should send a letter of application, a current curriculum vitae, copies of all undergraduate and graduate transcripts (official transcripts will be required of finalists), names and contact information of three references, a statement of teaching experience and philosophy, and a statement of research plans. Application materials should be sent to: **Chair, Organic Chemistry Search Committee, Department of Chemistry and Physics, Southeastern Louisiana University, SLU Box 10878, Hammond, LA 70402.** Information about the Department of Chemistry and Physics can be found at www.chem.selu.edu. Southeastern is an AA/ADA/EEO employer.

STATE UNIVERSITY OF NEW YORK AT BINGHAMTON

Outstanding applicants are being sought for a tenure-track position in Organic Chemistry at the Assistant Professor level. We are currently pursuing growth in biological, materials, and environmental chemistry; thus a candidate whose research interfaces any of those areas would be especially attractive. BU (<http://www.binghamton.edu>) emphasizes high quality research and a commitment to excellence in graduate (PhD, MS) and undergraduate education. Applications, including curriculum vitae, detailed research plan, statement of teaching philosophy, and three letters of recommendation should be submitted online at <http://binghamton.interviewexchange.com>. Binghamton University is an Affirmative Action/Equal Opportunity Employer. Applications will be considered starting November 1, 2007.

ACADEMIC POSITIONS

SCHOOL OF CHEMICAL, BIOLOGICAL AND MATERIALS ENGINEERING UNIVERSITY OF OKLAHOMA FACULTY POSITION OPENING ASSISTANT, ASSOCIATE OR FULL PROFESSOR (TENURE-TRACK)

The School of Chemical, Biological and Materials Engineering (CBME) at The University of Oklahoma invites applications for a tenured/tenure track faculty position. Starting date is flexible, but as early as spring, 2008. The School is particularly interested in strengthening the University-wide program in biofuels and biomass conversion (e.g., biomass pyrolysis or gasification, biorefinery streams separation, catalytic conversion, bioconversion). Other areas of interest are nanotechnology, surfactant technology, and engineering education and outreach. Exceptional candidates with research expertise in other fields will also be considered. Candidates must hold an earned doctorate in chemical engineering or closely related discipline. Rank and salary will be commensurate with experience and qualifications. Successful candidates will be committed to excellence in both research and teaching, and they will function effectively in a multidisciplinary research environment. Experience in technology transfer is desirable. CBME offers competitive startup packages, exciting opportunities for research collaboration, and a supportive environment for new faculty. Candidates should send a resume, description of research plans, teaching interests, and names of three references to: **Search Committee, School of Chemical, Biological and Materials Engineering, The University of Oklahoma, 100 East Boyd, SEC T335, Norman, OK 73019-1004.** Applications will be reviewed until candidates are selected and recommended for appointment. *The University of Oklahoma is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.*

FACULTY POSITION – ORGANIC CHEMISTRY – UNIVERSITY OF ARKANSAS

The Department of Chemistry and Biochemistry at the University of Arkansas is seeking an outstanding scientist for a tenure-track faculty position in Organic Chemistry, broadly defined. The department has state-of-the-art core facilities in NMR spectroscopy, protein and small molecule X-ray crystallography, mass spectrometry, and organic synthesis. The successful candidate will be associated with the NIH NCCR Center for Protein Structure and Function (<http://www.uark.edu/chemistry>). Collaborative, multidisciplinary research projects are encouraged. Successful candidates must have a Ph.D. and will be expected to establish a nationally funded research program, and teach effectively at the graduate and undergraduate levels. Review of completed applications will begin on October 15, 2007, and will continue until the position is filled. Curriculum vitae, statements of research plans and teaching interests, and three letters of recommendation should be sent by electronic or postal mail to: **Dr. Matt McIntosh, Faculty Search Committee, Department of Chemistry and Biochemistry, University of Arkansas, Fayetteville, AR 72701 (mcintosh@uark.edu).** *Women and minority candidates are strongly encouraged to apply. The University of Arkansas is an Affirmative Action/Equal Opportunity Employer.* All applicants are subject to public disclosure under the Arkansas Freedom of Information Act, and persons hired must have proof of legal authority to work in the United States. This position will be filled based on administrative approval.

UNIVERSITY OF OREGON Organic Chemistry Faculty Position. The Department of Chemistry invites applications for a tenure-track position in organic chemistry (broadly defined) beginning Fall 2008 at the rank of assistant or associate professor. The potential for establishing a vigorous independent research program in organic chemistry and active participation and excellence in teaching at the undergraduate and graduate levels will be the most important criteria for selection. A PhD is required and postdoctoral experience is preferred. We seek candidates with a demonstrated commitment to working effectively with students, faculty and staff from diverse backgrounds. To assure full consideration, apply at <http://UOChemjobs.uoregon.edu>, and then mail a curriculum vitae and a statement of research plans and objectives by Monday, October 22, 2007, and arrange for three letters of recommendation to be sent to: **Organic Search Committee, 1253 Department of Chemistry, University of Oregon, Eugene, OR 97403-1253.** *The University of Oregon is an EO/AA/ADA institution committed to cultural diversity.*

ACADEMIC POSITIONS

UNIVERSITY OF CALIFORNIA, IRVINE – LECTURER WITH POTENTIAL FOR SECURITY OF EMPLOYMENT IN CHEMISTRY. The Department of Chemistry at the University of California, Irvine invites applications for a Lecturer position with potential for security of employment. This position parallels the tenure track research faculty series and will involve coordinating the undergraduate organic chemistry laboratory classes and some teaching of the attendant lecture course. We seek outstanding Ph.D.s with innovative ideas for laboratory instruction applicable to a large organic chemistry teaching laboratory program. Integration of the laboratory experiments with the lectures is essential. Successful candidates are expected to develop curricula and instructional initiatives with national visibility and to publish in scholarly educational journals. Applications should be submitted electronically by the Web and should include a cover letter, curriculum vitae, a list of publications, and a description of the applicant's university-level teaching background and philosophy. Applicants should also arrange to have three letters of recommendation submitted on their behalf. Application instructions can be found at <https://recruit.ap.uci.edu/>. Review of applications will begin December 15, 2007. To ensure full consideration, applications and all supporting materials should be received by this time. The position will remain open until filled. Information about programs can be found at <http://www.chem.uci.edu> or you may contact: **Professor David Van Vranken, Chair, Chemistry Lecturer Search Committee, Department of Chemistry, 1102 Natural Sciences II, University of California, Irvine, Irvine, CA 92697-2025.** Email: david.vv@uci.edu. *The University of California, Irvine is an equal opportunity/affirmative action employer committed to excellence through diversity. UC Irvine has an active Career Partners Program and has an ADVANCE Gender Equity Program.*

THE DEPARTMENT OF CHEMISTRY AT THE UNIVERSITY OF MICHIGAN invites applications for an anticipated position at the rank of assistant professor or associate professor in any subdiscipline of chemistry with a proposed start date of September 1, 2008. Priority will be given to applicants who have interests in the area of organic chemistry, but outstanding candidates in all other areas are also encouraged to apply. This would be a University-year appointment (9-mos. academic salary with 3 mos. research supported salary.) Candidates are expected to develop an internationally recognized program of scholarly research and to excel in teaching at undergraduate and graduate levels. Detailed information regarding the electronic application process and required materials is available on-line at (<https://www.chem.lsa.umich.edu/chem/facultyrecruit/>). The position will remain open until filled but preference will be given to applicants who have submitted all requested materials prior to Oct 15th, 2007. Information about the Chemistry Department is available on the web site, www.umich.edu/~michchem. Questions about the application process should be sent to chemfac07@umich.edu. *Women and minorities are encouraged to apply. The University of Michigan is supportive of the needs of dual career couples and is a non-discriminatory, affirmative action employer.*

THE UNIVERSITY OF CENTRAL ARKANSAS (UCA) is seeking applications and nominations for the position of Chair of the Department of Chemistry. The department consists of 15 tenured or tenure-track faculty, is housed in a dedicated four-story building, and offers the ACS-approved degree in chemistry. The department has a long history in undergraduate education in terms of both classroom instruction and the inclusion of undergraduates in research and scholarly activity. The candidate is expected to have an earned Ph.D. in Chemistry or Biochemistry, be a successful classroom instructor, possess strong leadership and administrative skills, and be active in the discipline. Significant experience with undergraduate involvement in research is desirable. The appointment will be made at the Professor or Associate Professor level and the anticipated starting date is July 1, 2008. Candidates should submit a letter of application, curriculum vitae, statement of teaching and administrative philosophy, and contact information for at least three references to: **Dr. Steven Runge, Chemistry Chair Search Committee, College of Natural Sciences and Mathematics, 105 Lewis Science Center, University of Central Arkansas, Conway, AR 72035.** Review of applications will begin on November 1, 2007, and continue until the position is filled. *UCA is an Equal Opportunity/Affirmative Action Employer.*

ACADEMIC POSITIONS

UNIVERSITY OF FLORIDA FACULTY POSITION IN CHEMISTRY

The Department of Chemistry at the University of Florida announces a search for a tenure-track faculty member, at the level of Assistant Professor, to begin in Fall 2008. Candidates with research interests in the general area of Biochemistry are invited to apply, and applications in the areas of Bioinorganic and Metallo-biochemistry will be of special interest. In addition to contributing to the research, teaching and service missions of the Department of Chemistry, the successful candidate will have numerous opportunities for campus-wide interactions with faculty in the Colleges of Liberal Arts and Sciences, Medicine and Engineering, and other University-based Centers and Institutes, including the National High Magnetic Field Laboratory. Applicants should submit a curriculum vitae, brief descriptions of their research plans, their graduate/undergraduate teaching interests, and arrange to have three letters of recommendation sent on their behalf to the **Faculty Search Committee, Department of Chemistry, Box 117200, University of Florida, Gainesville, FL 32611-7200** on or before October 19, 2007. *The University of Florida is an equal opportunity employer and welcomes nominations and applications from women and minority group candidates.*

TENURE TRACK FACULTY POSITION IN ORGANIC CHEMISTRY

The Department of Chemistry at the University of Wyoming invites applications for a tenure-track position in organic chemistry at the assistant professor level. A Ph.D. is required; postdoctoral experience is desirable. Applicants with research interests in biological systems, neuroscience, or energy science are especially encouraged to apply. Excellence in research, teaching, and advising at both the graduate and undergraduate levels will be expected of a successful candidate. Teaching loads are commensurate with the expectation of a strong, externally-funded research program. For additional information, see our web site at <http://www.uwyo.edu/chemistry/> or e-mail to chemistry@uwyo.edu. Applicants should send a CV, research proposal(s) with estimate of start-up costs, brief statement of teaching interests and arrange for three letters of recommendation to be sent to: **Organic Faculty Search Committee, Department of Chemistry, Dept. 3838, 1000 E. University Ave., University of Wyoming, Laramie, WY 82071**. Review of applications will begin October 26, 2007 and continue until suitable candidates are identified. *The University of Wyoming is an Affirmative Action/Equal Opportunity Employer. Minority and women candidates are strongly encouraged to apply.*

UNIVERSITY OF COLORADO – FACULTY POSITION IN ORGANIC CHEMISTRY. The Department of Chemistry and Biochemistry at the University of Colorado invites applications for a tenure track faculty position in the area of synthetic organic chemistry. Although preference will be given to applicants at the Assistant Professor level, outstanding candidates at the Associate or Full Professor level will also be considered. Of particular interest are candidates with research programs in natural products synthesis, methods development, or chemical biology. A Ph.D. in Chemistry is required. Applicants at the Assistant Professor level should submit a curriculum vitae, Undergraduate and Graduate transcripts, a description of proposed research and arrange to have three letters of recommendation sent to **Professor Andy Phillips, Chair, Organic Search Committee, Department of Chemistry and Biochemistry, University of Colorado, Boulder, CO 80309-0215**. Applicants at the Associate or Full Professor level should submit a curriculum vitae and a statement of research plans. Review of applications will begin October 16, and will continue until the position is filled. *The University of Colorado at Boulder is committed to diversity and equality in education and employment.*

ASSISTANT PROFESSOR IN ORGANIC CHEMISTRY. Université de Sherbrooke (QC-Canada). All areas of organic chemistry will be considered. However, a particular attention will be directed toward applications in relation with the current strategic orientations of the Department (pharmaceutical chemistry, environment, materials). Candidates with a Ph.D. degree in chemistry are invited to send their cv, a description of their teaching interests, a detailed research proposal and 3 reference letters to: **Doyen, Fac. Sciences, Offer # 07-6-08-26, Univ. de Sherbrooke, 2500 boul. Université, Sherbrooke (Qc) Canada J1K 2R1**. For further details, go to: www.usherbrooke.ca/srh/offres.html. professeurs, offer # 07-6-08-26.

ACADEMIC POSITIONS

CHEMISTRY/ENVIRONMENTAL STUDIES AT TRANSYLVANIA UNIVERSITY

Transylvania University (<http://www.transy.edu/>), an independent, residential, liberal arts college of 1,150, invites applications for a full-time, Tenure-Track Position At The Assistant Professor Level in chemistry/environmental studies beginning September 1, 2008. Ph.D. required. Classes to be taught include General Chemistry, and courses to support an Environmental Studies minor. Possible specialty areas include geochemistry, environmental toxicology or environmental biochemistry. Teaching opportunities may also include periodic contribution to the College's Foundations of the Liberal Arts program. Bingham Awards for Excellence in Teaching may provide substantial salary supplements for exceptional candidates or smaller start-up awards for recent Ph.D.s. Applications including curriculum vitae, graduate and undergraduate transcripts, and three letters of recommendation should be sent to **Dr. Alan Goren, agoren@transy.edu or 300 North Broadway, Lexington, KY 40508**. In your cover letter please identify and describe two specialty courses you would like to teach and how you plan to actively engage undergraduates through your teaching and research. This position is open until filled; but to assure full consideration, applications should be received no later than October 30, 2007. *Transylvania University is an Equal Opportunity Employer and is committed to building a faculty that reflects the diversity of American society.*

DEPARTMENT OF CHEMISTRY LOYOLA UNIVERSITY CHICAGO. The Department of Chemistry invites applications for a tenure track position at the Assistant Professor level in biochemistry. Applicants from all areas of Biological Chemistry will be considered, however, preference will be given to candidates with research interests in experimental biophysical chemistry, biomaterials, or biomolecular structure and function. A Ph.D. in chemistry or biochemistry is required. The successful candidate will be expected to maintain an internationally competitive, externally funded research program and participate in graduate and undergraduate teaching. The Department offers PhD, MS, and ACS approved BS degrees. The application should include a Curriculum Vitae, a detailed description of research and teaching interests, and at least three letters of recommendation. Please send application information to: **Biochemistry Search Committee, Department of Chemistry, Loyola University Chicago, 1068 W. Sheridan Rd., Chicago, IL 60626**. Candidates must also register their application and submit an electronic CV at www.careers.luc.edu. Review of applications will begin on October 31, but applications will be accepted until the position is filled. *Minority and female applicants are especially encouraged to apply. Loyola University Chicago is an Equal Opportunity/Affirmative Action Employer.*

TENURE-TRACK FACULTY POSITION AT FLORIDA STATE UNIVERSITY PHYSICAL CHEMISTRY

The Department of Chemistry and Biochemistry invites applications for a tenure-track Assistant Professor position in experimental physical chemistry (broadly defined) to begin in Fall 2008. Candidates are expected to mount a highly creative interdisciplinary research program that is externally funded, and to contribute to graduate and undergraduate teaching in the Physical Chemistry Program in the Department. Applicants should send curriculum vitae, research plan, a statement of teaching philosophy and interests, and arrange to have three letters of recommendation sent to: **Chair, Physical Chemistry Search Committee, Department of Chemistry and Biochemistry, Florida State University, 95 Chieftain Way, Tallahassee, FL 32306-4390**. Review of applications will begin November 1, 2007, and will continue until the position is filled. *FSU is an Affirmative Action Equal Opportunity Employer: women, veterans, disabled persons, and members of underrepresented minorities are encouraged to apply.*

UNIVERSITY OF CALIFORNIA, MERCED MATERIALS CHEMISTRY

University of California, Merced has two positions in the School of Natural Sciences, one tenure-track Assistant Professor and one Professor at a tenured level. We seek applicants who will develop innovative research programs in materials chemistry, broadly defined, and contribute to building graduate and undergraduate programs in chemistry. To apply or for more information: <http://jobs.ucmerced.edu/n/academic/listings.jsf?seriesId=1>. AA/EOE

ACADEMIC POSITIONS

SEATTLE PACIFIC UNIVERSITY. Chemistry: Assistant or Associate Professor; tenure track position available September 2008. All areas of chemistry considered, including those with cross-disciplinary interests, e.g., organometallic, physical-environmental, bio-inorganic. Duties include teaching at both the freshman and upper division undergraduate levels, supervising undergraduate research, and serving on occasional all-university committees. Ph.D. in chemistry, biochemistry, or a closely related field and teaching experience required. Post-doctoral research experience preferred. More senior candidate should have a demonstrated record of teaching excellence, undergraduate research, and grant writing. Seattle Pacific University serves nearly 3,900 undergraduate and graduate students in both liberal arts and professional studies. As a Christian University rooted in the Wesleyan tradition, SPU is clearly evangelical, genuinely ecumenical and seeks applicants who are committed to its Christian mission. *The University is located in a cosmopolitan urban center with rich cultural diversity and is committed to building an excellent and diverse teaching faculty. Women and ethnic minorities are especially encouraged to apply.* Send a letter of interest, complete curriculum vitae and list of three references. Subsequently, application forms and further document requests will be made. Applications will be accepted until the position is filled. Send materials (electronic applications preferred) to **Professor Kevin Bartlett, Search Committee Chair, Department of Chemistry and Biochemistry, Seattle Pacific University, Seattle, WA 98119**. kibartle@spu.edu.

FACULTY POSITIONS UNIVERSITY OF NORTH DAKOTA

The Department of Chemistry invites applications for several tenure-track Assistant Professor positions starting in Fall 2008. We anticipate hiring one **Inorganic Chemist** and one **Physical Chemist**, but will consider all qualified applicants. The successful candidates are expected to establish vigorous, independent programs of externally-funded research and should be able to teach graduate and undergraduate courses in chemistry. UND Chemistry offers an ACS-certified B.S. degree, and M.S. and Ph.D. degrees. The Department has research focuses in energy-related catalysis and environmental chemistry. Candidates with interests in these areas that complement those of current faculty are especially encouraged to apply. A Ph.D. degree is required and postdoctoral experience preferred. Send resume, transcripts for all degrees, research plans, and three letters of recommendation to **Dr. David Pierce, Search Committee Chair, Department of Chemistry, University of North Dakota, 151 Cornell St. Stop 9024, Grand Forks, ND 58202-9024**. Completed applications must be received by November 15, 2007 for full consideration. Web site: <http://www.und.nodak.edu/dept/chem/>. *The University of North Dakota is an equal opportunity/affirmative action employer.*

VANDERBILT UNIVERSITY CHAIR

DEPARTMENT OF CHEMICAL ENGINEERING

Vanderbilt University invites applications and nominations for Chair of the Department of Chemical Engineering. The Department currently has approximately 120 undergraduates and 35 doctoral students. It features instruction and research in the areas of biological engineering, nanotechnology, materials synthesis and characterization, molecular modeling, and adsorption processes. Additional information is available at <http://www.che.vanderbilt.edu>. The Department seeks a distinguished scholar committed to teaching and research. The candidate must have the ability to work effectively with faculty and the constituents of the Department to define long-term directions and the ability to enhance the graduate and research efforts while maintaining a strong undergraduate program. Candidates must have an earned doctorate in Chemical Engineering or a closely related discipline with professional achievements that would justify an appointment as full professor with tenure. Applicants should send a letter of interest, a resume, and names, addresses, phone numbers, and e-mail addresses of four references to: **Professor K. Arthur Overholser, ChE Chair Search Committee, Vanderbilt University School of Engineering, VU Station B #351826, 2301 Vanderbilt Place, Nashville, TN 37235-1826**. Applications in electronic form are particularly encouraged. Please send the above-referenced information in Word or PDF format to: ChEChairSearch@vanderbilt.edu. *An Equal Opportunity/Affirmative Action Employer*

ACADEMIC POSITIONS

DEPARTMENT OF CHEMISTRY LOYOLA UNIVERSITY CHICAGO. The Department of Chemistry invites applications for a tenure track position at the Assistant Professor level in inorganic chemistry. Applicants from all areas of inorganic chemistry will be considered, however, preference will be given to candidates whose research interests include biomaterials and/or bioinspired environmental nanotechnology. A Ph.D. in chemistry is required. The successful candidate will be expected to maintain an internationally competitive, externally funded research program and participate in graduate and undergraduate teaching. The Department offers PhD, MS, and ACS approved BS degrees. The application should include a Curriculum Vitae, a detailed description of research and teaching interests, and at least three letters of recommendation. Please send application information to: **Inorganic Search Committee, Department of Chemistry, Loyola University Chicago, 1068 W. Sheridan Rd., Chicago, IL 60626.** Candidates must also register their application and submit an electronic CV at www.careers.luc.edu. Review of applications will begin on October 31, but applications will be accepted until the position is filled. *Minority and female applicants are especially encouraged to apply. Loyola University Chicago is an Equal Opportunity/Affirmative Action Employer.*

UNIVERSITY OF COLORADO – FACULTY POSITION IN NANOSCIENCE

The Department of Chemistry and Biochemistry at the University of Colorado, Boulder invites applications for a tenure-track position in the area of nanoscience, at the rank of Assistant Professor. A Ph.D. in Chemistry is required. We are seeking applicants who will establish a vigorous and innovative research program in nanoscience, with a significant chemical synthesis component. Materials and systems under investigation can be centered in organic and/or inorganic chemistry. The successful applicant will contribute to the teaching program in their areas of expertise at both the undergraduate and graduate levels. Applicants should submit a curriculum vitae, Undergraduate and Graduate transcripts, a description of proposed research, and arrange to have three letters of recommendation sent to **Professor David M. Walba, Chair, Nanoscience Search Committee, Department of Chemistry and Biochemistry, University of Colorado, Boulder, CO 80309-0215.** Review of applications will begin November 1, 2007, and will continue until the position is filled. See <<http://www.Colorado.edu/ArtsSciences/Jobs/>> for full job description. *The University of Colorado at Boulder is committed to diversity and equality in education and employment.*

EXPERIMENTAL INORGANIC SOLID-STATE OR MATERIALS CHEMISTRY POSITION— UNIVERSITY OF HOUSTON

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The Department of Chemistry at Princeton University invites applications for a senior faculty position. Distinguished applicants in all areas of chemistry are welcome. Application should include a description of research interests, curriculum vitae, and a list of publications. Send by November 1, 2007 to: **Ms. Linda Peoples, Assistant to the Chair, Dept. of Chemistry, Princeton University, Princeton, NJ 08544-1009.** *Princeton University is an equal opportunity employer and complies with applicable EEO and affirmative action regulations.* For general application information and information about self-identification, please see <http://web.princeton.edu/sites/dof/ApplicantsInfo.htm>.

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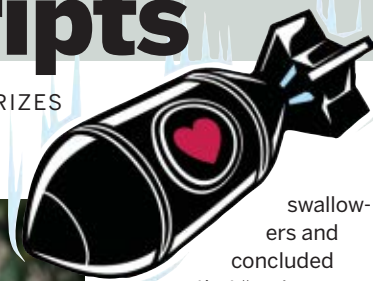
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swallow-
ers and
concluded

that "major complications are more likely when the swallower is distracted or swallows multiple or unusual swords" and also that "sore throats are common."

Cupid-inspired scientists at the Air Force Wright Laboratory, in Dayton, Ohio, took home the **PEACE PRIZE** for their 1994 research project toward the develop-



Medicine: Hard to swallow.
Peace: Love-bombs away.

DREAMSTIME (BOTH)

It's early October and everyone is waiting by the phone to hear if they've nabbed one of those renowned prizes. The Nobel Prizes? No, that's next week. This week, NewscripTS is devoted to the **SPECIAL WINNERS** of the Ig Nobel Prizes, which honor "achievements that first make people laugh and then make them think," according to the folks at the *Annals of Improbable Research*, who administer the awards.

Aflutter or perhaps aghast, seven of the 10 winners traveled—at their own expense—to Harvard University to receive their prizes. As always, the awards were physically handed to the Ig Nobelists by genuine Nobel Laureates, including Chemistry Nobelists William Lipscomb (1976) and Dudley Herschbach (1986). Awardees had 60 seconds to deliver their acceptance speech before a "cute-but-implacable eight-year-old girl" taunted them offstage to the tune, "Please stop. I'm bored."

This year's **CHEMISTRY PRIZE** went to Mayu Yamamoto of the International Medical Center of Japan for developing a method to extract lignin-derived vanillin from cow dung (*Aroma Res.* **2006**, 7, 258). Yamamoto reports that she has "developed a method for the production of plant polyphenol including vanillin with the herbivorous animals' excrement as a natural resource of lignin by using a high pressure and high temperature reaction."

In honor of Yamamoto's achievement, Cambridge, Mass.-based Toscanini's Ice Cream has created a new ice cream flavor: Yum-a-Moto Vanilla Twist.

Think that's hard to swallow? This year's **MEDICINE PRIZE** went to Brian Witcombe, a radiologist in Gloucester, England, and Dan Meyer, executive director of the Tennessee-based Sword Swallowers Association for their paper "Sword Swallowing and Its Side Effects" (*Brit. Med. J.* **2006**, 333, 1285). In this penetrating medical report, Witcombe and Meyer surveyed 110 sword



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ment of "a chemical weapon that will make enemy soldiers become sexually irresistible to each other" (www.sunshine-project.org/incapacitants/jnlwdpdf/wpafbchem.pdf).

Glenda Browne of Blaxland, Australia, garnered the **LITERATURE PRIZE** "for her study of the word 'the'—and of the many ways it causes problems for anyone who tries to put things into alphabetical order" (*Indexer* **2001**, 22, 119).

Finally, we'd be remiss if we didn't mention Kuo Cheng Hsieh, of Taichung, Taiwan, who won this year's **ECONOMICS PRIZE** for his 2001 patent of a device that catches bank robbers by dropping a net over them (U.S. patent #6,219,959). According to the patent, the device "looks like a storing box and is installed above the entrance of the business. When a robbery takes place and the system is activated, an infrared detecting device determines if a robber is in a zone beneath the storing box. A net, a curtain, and a plurality of barriers will drop down immediately and simultaneously. After a lifting motor is activated, the system traps the robber and suspends him above the floor."

Marc Abrahams, mastermind of the Ig Nobel Prizes, closed the ceremony with these words of wisdom: "If you didn't win an Ig Nobel Prize tonight—and especially if you did—better luck next year."

A recording of the ceremony can be viewed at www.improbable.com, and an edited version of the event will be broadcast on Friday, Nov. 23, as part of National Public Radio's "Science Friday."

This week's column was written by BETHANY HALFORD. Please send comments and suggestions to newscripTS@accs.org.

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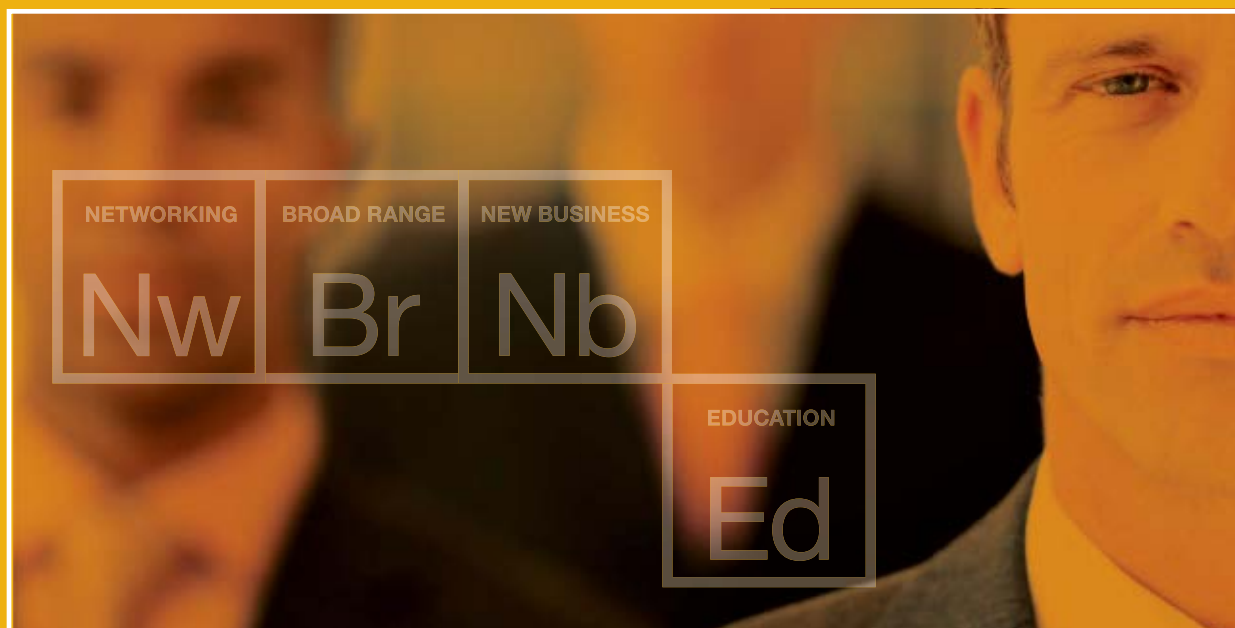
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